U.S. FISH AND WILDLIFE SERVICE
SPECIES ASSESSMENT AND LISTING PRIORITY ASSIGNMENT FORM

SCIENTIFIC NAME: Rana pretiosa

COMMON NAME: Oregon spotted frog

LEAD REGION: Region 1

INFORMATION CURRENT AS OF: October 2005

STATUS/ACTION

___ Species assessment - determined we do not have sufficient information on file to support a proposal to list the species and, therefore, it was not elevated to Candidate status

___ New candidate

_X_ Continuing candidate

___ Non-petitioned

_X_ Petitioned - Date petition received: 5-4-89; 5-11-04

_X_ 90-day positive - FR date: 10-17-89

_X_ 12-month warranted but precluded - FR date: 5-7-93

_No_ Did the petition request a reclassification of a listed species?

FOR PETITIONED CANDIDATE SPECIES:

a. Is listing warranted (if yes, see summary of threats below)? yes

b. To date, has publication of a proposal to list been precluded by other higher priority listing actions? _yes

c. If the answer to a. and b. is "yes", provide an explanation of why the action is precluded. We find that the immediate issuance of a proposed rule and timely promulgation of a final rule for this species has been, for the preceding 12 months, and continues to be, precluded by higher priority listing actions. During the past 12 months, almost our entire national listing budget has been consumed by work on various listing actions to comply with court orders and court-approved settlement agreements, meeting statutory deadlines for petition findings or listing determinations, emergency listing evaluations and determinations, and essential litigation-related, administrative, and program management tasks. We will continue to monitor the status of this species as new information becomes available. This review will determine if a change in status is warranted, including the need to make prompt use of emergency listing procedures. For information on listing actions taken over the past 12 months, see the discussion of "Progress on Revising the Lists," in the current CNOR which can be viewed on our Internet website (http://endangered.fws.gov/).

Listing priority change

Former LP: ___

New LP: ___

Date when the species first became a Candidate (as currently defined): 5-19-97 (CNOR recognizing taxonomic changes for "spotted frogs")

__ Candidate removal: Former LPN: ___

___ A – Taxon is more abundant or widespread than previously believed or not subject to the degree of threats sufficient to warrant issuance of a proposed listing or continuance of candidate status.
___U – Taxon not subject to the degree of threats sufficient to warrant issuance of a proposed listing or continuance of candidate status due, in part or totally, to conservation efforts that remove or reduce the threats to the species.
___ F – Range is no longer a U.S. territory.
___ I – Insufficient information exists on biological vulnerability and threats to support listing.
___ M – Taxon mistakenly included in past notice of review.
___ N – Taxon does not meet the Act's definition of "species."
___ X – Taxon believed to be extinct.

ANIMAL/PLANT GROUP AND FAMILY: Amphibian; Ranidae (True Frogs)

HISTORICAL STATES/TERRITORIES/COUNTRIES OF OCCURRENCE: Washington, Oregon, California, British Columbia (Canada)

CURRENT STATES/ COUNTIES/TERRITORIES/COUNTRIES OF OCCURRENCE: Washington (Klickitat, Skamania, and Thurston Counties), Oregon (Deschutes, Klamath, Jackson, Lane, and Wasco Counties), British Columbia (Canada)

LAND OWNERSHIP

The species currently is known from 39 sites. Of these, 3 are in British Columbia, 7 in Washington, and 29 in Oregon. Land ownership is described below (also see Table 1).

In Washington, two Thurston County Oregon spotted frog populations occur on private land, and two populations occur on National Wildlife Refuge (NWR) land (Black River Unit of the Nisqually NWR). The two Trout Lake sites are on both private and public land, including the Washington Department of Natural Resources' Trout Lake Natural Area Preserve (NAP) and Gifford Pinchot National Forest. The Conboy Lake population occurs predominately within the Conboy Lake NWR, with the remaining portion on privately owned land.

In Oregon, 89 percent of the Oregon spotted frog populations are at least partially in public ownership (Forest Service, Bureau of Land Management (BLM), and NWR). Sites in the Deschutes drainage (La Pine, Little Deschutes River, and Sunriver Nature Center) are under private ownership. Small portions of the Little Deschutes River locality are also managed by the BLM. Fourteen of the remaining sites are within the Deschutes National Forest. One site is managed by the Mount Hood National Forest, with a small portion of it on privately owned land. All localities in the Willamette drainage are under the management of the Willamette National Forest. These localities include Gold Lake Bog (a Research Natural Area) and several sites within the Three Sisters Wilderness Area. The five sites in the Klamath Basin are under both Federal and private management. The Klamath Marsh NWR is managed by the FWS, but portions of that population also occur on private lands. The Wood River wetlands locality includes land managed by BLM and private land. The Fourmile Creek and Buck Lake localities

include private, BLM, and Winema National Forest lands. The Jack Creek population is on the Winema National Forest and privately owned land. Five more recently discovered sites include three on Forest Service land, and two that are partly on BLM land and partly on private land. Most potential habitat on private lands adjacent to public lands has not been adequately surveyed for Oregon spotted frogs.

LEAD REGION CONTACT: Paul Phifer (503) 872-2823

LEAD FIELD OFFICE CONTACT: Western Washington Fish and Wildlife Office; Deanna Lynch (360/753-9545)

BIOLOGICAL INFORMATION
Species Description

The Oregon spotted frog is named for the characteristic black spots covering the head, back, sides, and legs. The dark spots have ragged edges and light centers, usually associated with a tubercle or raised area of skin. These spots become larger and darker, and the edges become more ragged with age (Hayes 1994). Body color also varies with age. Juveniles are usually brown or, occasionally, olive green on the back and white or cream colored with reddish pigments on the underlegs and abdomen (McAllister and Leonard 1997). Adults range from brown to reddish brown but tend to become redder with age. Large, presumably older, individuals may be brick red over most of the dorsal (back) surfaces (McAllister and Leonard 1997). Red surface pigments on the adult abdomen also increase with age, and the underlegs of adults are a vivid orange red. Tan to orange folds along the sides of the back (dorsolateral folds) extend from behind the eye to midway along the back (McAllister and Leonard 1997). The eyes are upturned; there is a faint mask, and a light jaw stripe extends to the shoulder. Small bumps and tubercles usually cover the back and sides (Leonard et al. 1993). The hind legs are short relative to body length, and the hind feet are fully webbed (Leonard et al. 1993).

The Oregon spotted frog is a medium-sized frog that ranges from about 44 to 100 millimeters (mm) (1.7 to 4.0 inches (in)) in body length (McAllister and Leonard 1997). Females are typically larger than males; females reach up to 100 mm (4 in) and males to 75 mm (3 in) (Leonard et al. 1993).

Morphological characters can be used to distinguish Oregon spotted frogs from other closely related spotted frogs. Mottling with dark pigments and fragmentation of the superficial red or orange-red wash on the abdomen can distinguish the Oregon spotted frog from some Columbia spotted frog populations (Green et al. 1997; Hayes 1997; Hayes et al. 1997). Coloration of the underlegs and abdomen, size and shapes of spots, groin mottling, eye positions, relative length of hind legs to body size, degree of webbing, behaviors, and other characteristics can be used to distinguish among adults of the closely related species in the Rana boylii group. However, tadpoles are difficult to distinguish among species (Dunlap 1955; Corkran and Thoms 1996; McAllister and Leonard 1997).

The Oregon spotted frog has a weak call consisting of a rapid series of six to nine low clucking notes described as sounding like a distant woodpecker's tapping. Males will call at any time,

both day and night, to attract females (McAllister and Leonard 1997). This species rarely vocalizes except during the breeding season (Leonard et al. 1993).

Taxonomy

The common name "spotted frog" and the scientific name Rana pretiosa (order Anura; family Ranidae) were first applied to a series of five specimens collected in 1841 by Baird and Girard (1853) from the vicinity of Puget Sound. However, two of these specimens were later determined to be northern red-legged frogs (Rana aurora aurora) (Hayes 1994; Green et al. 1997). Dunlap (1955) demonstrated the morphological differences between northern red-legged frogs, Cascades frogs, and spotted frogs (Hayes 1994). Subsequently, the "spotted frog" was separated into two species, Rana pretiosa and Rana luteiventris (Columbia spotted frog) based on genetic analyses (Green et al. 1996, 1997).

Microsatellite and mitochondrial DNA analyses of Oregon spotted frogs from 20 of the known populations in Oregon and Washington were surveyed for variation at 13 microsatellite loci (Blouin 2000). Fifteen of the populations and a sample from British Columbia were surveyed for mtDNA variation. Analyses indicate that Rana pretiosa is subdivided into four main groups: (1) the Chehalis drainage in Washington, (2) the Columbia drainage in Washington, (3) the central Cascades of Oregon, and (4) the Klamath basin (Blouin 2000). The Camas Prairie group in northern Oregon may be the last representative of a fifth genetic group. The Klamath basin group is the most distinct. The low numbers of alleles per locus and low heterozygosities in each population suggest low effective sizes in these Oregon spotted frog populations, with some populations much smaller and more isolated than others (e.g., Camas Prairie). Genetic connectedness is low on a small geographic scale. Results indicate low movement and/or substantial genetic drift occurs among populations. The Klamath basin, central Cascades and two Washington groups should be treated as four separate units for management purposes (Blouin 2000).

Life History

Male Oregon spotted frogs are not territorial and may gather in large groups of 25 or more individuals at specific locations (Leonard et al. 1993). Breeding occurs in February or March at lower elevations and in late May or early June at higher elevations (Leonard et al. 1993). In the Klamath drainage breeding at Buck Lake occurs between April and May, indicating breeding may vary with latitude (i.e., southern populations may breed earlier than more northern populations) (M. Hayes, Portland State University, pers. comm. 1999). Males and females probably separate soon after egg laying with females returning to fairly solitary lives. Males may stay at the breeding site, possibly for several weeks, until egg-laying is completed (McAllister and Leonard 1997).

Oregon spotted frogs' eggs are extremely vulnerable due to the species' laying habits. Females may deposit their egg masses at the same locations in successive years, indicating the sites may have unique characteristics (Licht 1971). Observations of marked individuals are required to determine if the same females return to the same egg laying site each year or if it is the habitat conditions that generally attract female Oregon spotted frogs to the same site each year (Ken Riesenhoover, Port Blakely Tree Farms, LP, pers. comm. 2004). Traditional egg-laying (oviposition) sites may have limited availability because of unique characteristics, and adults

may have limited flexibility to switch sites. This makes the Oregon spotted frog particularly vulnerable to oviposition site modification (Hayes 1994). Although egg masses are occasionally laid singly, the majority of egg masses are laid communally in groups of a few to several hundred (Licht 1971; Nussbaum et al. 1983; Cooke 1984; Hayes et al. 1997; Engler and Friesz 1998). They are laid in shallow, often temporary, pools of water; gradually receding shorelines; on benches of seasonal lakes and marshes; and in wet meadows. These sites are usually no more than 15 centimeters (cm) (6 in) deep (Leonard et al. 1993), and most of these sites dry up later in the season (Joe Engler, U.S. Fish and Wildlife Service (FWS), pers. comm. 1999). Shallow water is easily warmed by the sun, and warmth hastens egg development (McAllister and Leonard 1997). However, laying eggs in shallow water can result in high mortality rates for eggs due to freezing or the drying out of the pool.

Licht (1974) documented highly variable mortality rates for spotted frog embryos (30 percent), tadpoles (99 percent), and post-metamorphic (after the change, or metamorphosis, from tadpole to adult) frogs (95 percent). Adults had a mortality rate of 36 percent over 2 years of the study, and males had a higher mortality than females (Licht 1974). A 27 percent minimum overwinter survival rate was indicated by a mark-recapture study at Dempsey Creek in Washington in 1997 and 1998 (K. McAllister, Washington Department of Fish and Wildlife (WDFW) pers. comm. 1999).

Adults begin to breed by 1–3 years of age, depending on elevation and latitude. Males may breed at 1 year at lower elevations and latitudes but generally require a second year to reach maturity at other sites. Females breed by 2 or 3 years of age, depending on elevation and latitude. Longevity of the species is incompletely understood. Observations of lines of arrested growth (LAGs) in bone cross sections suggest younger frogs generally compose the bulk of examined populations, but also indicate longevity can vary between sites and years. Most male Oregon spotted frogs probably only survive to 2–3 years of age (McAllister and Leonard 1997; M. Hayes, pers. comm. 2002). However, one adult male, marked as an adult in 1997, has been recaptured several times, including spring 2004. His age is estimated to be at least 9 years (K. McAllister, pers. comm. 2004). Five Oregon spotted frogs marked in 1997 and recaptured in 1999 at Jack Creek in Oregon were estimated to be from 4 to 5 years old (Forbes and Peterson 1999). Several Oregon spotted frogs re-captured at Jack Creek have been full adults for 7 and 8 years (J. Oertley, U.S. Forest Service, pers. comm. 2005). One female near Wickiup reservoir was aged at 3 years in 2000, and subsequently recaptured through fall 2004 (C. Pearl, U.S. Geological Survey Biological Resources Division, pers. comm. 2005; J. Bowerman, SunRiver Nature Center, pers. comm. 2005).

Tadpoles are grazers, having rough tooth rows for scraping plant surfaces and ingesting plant tissue and bacteria. They also consume algae, detritus, and probably carrion (Licht 1974; McAllister and Leonard 1997). Tadpoles metamorphose into froglets (about 16–26 mm (0.6–1.1 in) in length) during their first summer (Leonard et al. 1993; C. Pearl and J. Bowerman, pers. comm. 2005).

Live animals, primarily insects, are the prey of post-metamorphic Oregon spotted frogs. The most important prey groups include leaf beetles (Chrysomelidae), ground beetles (Carabidae), spiders (Arachnidae), rove beetles (Staphylinidae), syrphid flies (Syrphidae), long-legged flies

(Dolichopodidae), ants (Formicidae), and water striders (Gerridae). Oregon spotted frogs also eat newly metamorphosed red-legged frogs and western toad (Bufo boreas) juveniles at multiple sites in Oregon (McAllister and Leonard 1997; Pearl and Hayes 2002; Pearl et al. 2005; M. Hayes, pers. comm. 1999).

Oregon spotted frogs have a number of documented and potential natural predators. These include garter snakes (Thamnophis species (spp.)), great blue herons (Ardea herodias), green-backed herons (Butorides virescens), American bitterns (Botaurus lentiginosus), belted kingfishers (Ceryle alcyon), sandhill cranes (Grus canadensis), raccoons (Procyon lotor), coyotes (Canis latrans), striped skunks (Mephitis mephitis), mink (Mustela vison), river otters (Lutra canadensis), and feral house cats (Felis domesticus) (McAllister and Leonard 1997). Tadpoles may be preyed upon by numerous vertebrate predators including belted kingfishers, hooded mergansers (Lophodytes cucullatus), common garter snakes, western terrestrial garter snakes (Thamnophis elegans), larval and adult roughskin newts (Taricha granulosa), larval northwestern salamanders (Ambystoma gracile), cutthroat trout (Oncorynchus clarki), Olympic mudminnows (Novumbra hubbsi), and three-spined sticklebacks (Gasterosteus aculeatus). Invertebrate predators include dytiscid beetles (Dytiscus spp.), giant water bugs (Lethocerus americanus), backswimmers (Notonecta undulata and N. kirbyi), water scorpions (Ranatra sp.), dragonfly nymphs (Odonata), and leeches (Lethocerus americanus). Leeches and other invertebrates and roughskin newts are likely egg predators (McAllister and Leonard 1997).

The introduction of nonnative species into the historic range of the Oregon spotted frog possibly contributed to the decline of this and other species of frogs (Hayes and Jennings 1986; Hayes 1994; 61 FR 25813; McAllister and Leonard 1997; J. Engler, pers. comm. 1999; Pearl et al. 2004). Bullfrogs (Rana catesbeiana) are known predators of Oregon spotted frogs (M. Hayes, J. Engler, C. Pearl, pers. obs.), and introduced fish such as brook trout (Salvelinus fontinalis) and centrarchids are also likely predators.

Habitat

The Oregon spotted frog inhabits emergent wetland habitats in forested landscapes, although it is not typically found under forest canopy. Historically, this species was also associated with lakes in the prairie landscape of the Puget lowlands (McAllister and Leonard 1997). This is the most aquatic native frog species in the Pacific Northwest. It is almost always found in or near a perennial body of water, such as a spring, pond, lake, sluggish stream, irrigation-type canal, or roadside ditch (J. Engler, pers. comm. 1999). The observation that extant Oregon spotted frog populations tend to occur in larger wetlands led Hayes (1994) to hypothesize that a minimum size of 4 hectares (ha) (9 acres (ac)) may be necessary to reach suitably warm temperatures and support a large enough population to persist despite high predation rates (Hayes 1994). However, Oregon spotted frogs also occupy smaller sites. Oregon spotted frogs have been found at elevations ranging from near sea level in the Puget Trough lowlands in Washington to approximately 1,500 meters (m) (5,000 feet (ft)) in the Oregon Cascades in western Oregon (Dunlap 1955; Hayes 1997; McAllister and Leonard 1997; Pearl and Hayes 2004).

Results of a habitat utilization study at Dempsey Creek in Washington indicate that adult frogs move to remnant pools in response to reduced water levels from spring to summer (Watson et al.

1998, 2000, 2003). Oregon spotted frogs disperse from these pools during periods of increased precipitation in September and October. Oregon spotted frogs stayed within the study area throughout the year. Individuals equipped with radio transmitters stayed within 800 m (2,600 ft) of capture locations. Three Oregon spotted frogs (one male and two females) marked in a study at Dempsey Creek and the Black River in Washington moved a distance of 2.4 km (1.5 mi) along lower Dempsey Creek to the creek's mouth from the point where they were marked (McAllister and Walker 2003). Oregon spotted frogs, however, were not detected along the Black River between breeding populations in that study. Recaptures of Oregon spotted frogs in the Buck Lake population in Oregon indicated that adults often move less than 100 m (300 ft) between years (Hayes 1998b).

Oregon spotted frogs at Dempsey Creek selected areas of relatively shallow water with less emergent vegetation but more submergent vegetation than adjacent habitats. They avoided dry, upland areas of pasture grass (Watson et al. 1998, 2000, 2003). Radio telemetry data indicates Oregon spotted frogs at Dempsey Creek also make extensive use of scrub-shrub wetland habitats adjacent to forested uplands (K. Riesenhoover, pers. comm. 2004). Cooke (1984), however, stated that spotted frogs will forage for insects and other invertebrates in adjacent woods and meadows.

Oregon spotted frogs breed in shallow pools (5–30 cm (2–12 in) deep) that are near flowing water, or which may be connected to larger bodies of water during seasonally high water or at flood stage. Characteristic vegetation includes grasses, sedges, and rushes, although eggs are laid where the vegetation is low or sparse (McAllister and Leonard 1997). While native vegetation is the preferred substrate, the frog may also use short, manipulated canarygrass/native vegetation mix (J. Engler, pers. comm. 1999).

Throughout most of their range, Oregon spotted frogs remain in warmwater marshes except during the overwintering period. In the Klamath Marsh NWR, Oregon spotted frogs use cool (<12 C) water throughout the summer. Recent data indicate that overwintering sites are associated with springs or other locations with low-flow conditions. This choice of overwintering site may result from an avoidance of sites that could freeze (M. Hayes, pers. comm. 1999). Oregon spotted frogs apparently burrow in mud, silty substrate, or clumps of emergent vegetation when inactive during periods of prolonged or severe cold (Hayes 1994; McAllister and Leonard 1997). This species is generally inactive during the winter, except on warmer days.

Historical Range/Distribution

Historically, the Oregon spotted frog ranged from British Columbia to the Pit River drainage in northeastern California (Hayes 1997; McAllister and Leonard 1997). Oregon spotted frogs were documented in 59 historic localities: 1 in British Columbia, 3 in California, 44 in Oregon, and 11 in Washington (Hayes 1997; McAllister and Leonard 1997). In Washington, the species was historically documented in Clark, King, Klickitat, Pierce, Skagit, Snohomish, and Thurston Counties. In Oregon historic sites were found in Multnomah, Clackamas, Marion, Linn, Benton, Jackson, Lane, Wasco, Deschutes, and Klamath Counties.

Current Range/Distribution

Currently, the Oregon spotted frog is found from extreme southwestern British Columbia south through the Puget/Willamette Valley Trough, and in the Cascades Range from south-central Washington at least to the Klamath Basin in Oregon. Populations are currently known to occur only in Klickitat, Skamania, and Thurston Counties, Washington (Leonard 1997; McAllister and Leonard 1997). In Oregon, this species now occurs in Deschutes, Klamath, Jackson, Lane, and Wasco Counties (Hayes 1994, 1997). In California, this species has not been detected at historic sites and may be extirpated; however, there has not been an adequate survey of potential habitat, so this species may still occur in California.

Population Estimates/Status

Of the 59 historic localities where the species' previous existence can be verified (e.g., museum specimens, photographs, reliable published records), only 14 have been confirmed as being occupied in recent years (Hayes 1997; McAllister and Leonard 1997). The species may no longer occur in as much as 90 percent of its former range when the geographical and elevational biases in the collections of historic specimens are considered (Hayes 1997). However, Hayes' (1997) analysis did not include two historic populations in British Columbia reported by Carl and Cowan (1945); therefore the rangewide loss is probably higher than 90 percent (Haycock 2000).

Currently, 36 Oregon spotted frog locations (sites) are known in the U.S. including 7 in Washington (1 historic, 6 new) and 29 in Oregon (12 historic, 17 new) (Table 1). Oregon spotted frogs have not been documented in recent surveys in California. In British Columbia, six populations have been documented; however, Oregon spotted frogs cannot be confirmed at the three historic sites and the three recently discovered populations appear to be isolated from one another (Haycock 2000). The total number of breeding Oregon spotted frogs in Canada was estimated to be 350 in 2001 (Environment Canada 2005).

Table 1. Summary of most recent information on current number of known occupied sites, land ownership, estimated adult population, estimated eggmasses, and comments regarding the status of the Oregon spotted frog. (See text for details and citations.)

Site and Ownership	Adults	Egg Masses Counted	Comments
British Columbia – 3 sites	350 breeding frogs estimated as of 2001		Occurrence not confirmed at 3 other historic sites
Washington – 7 sites			
▪ Beaver Creek – Private		58 (2001) 107 (2000)	Threats include gravel mine and vegetation succession
▪ Dempsey Creek, Thurston Co. – Private	440 captured in 2004 241 captured in 2002	124 (2002) 183 (1999) 119 (1998) 125 (1997) 172 (1996)	Survey in 2003 found the populations occupied a larger area than previously recognized Threats include vegetation succession if grazing is removed, and residential development
▪ 110th Avenue – USFWS (Nisqually NWR)	2 in 2005; 4 captured in 2004	1 (2005) 1 (2004)	This site was discovered in 2001. Threats include reed canary grass and bullfrogs
▪ 123rd Avenue – USFWS (Nisqually NWR)	240 captured in 2004	>125 (2004)	This site was discovered in 2001. Threats include vegetation succession
▪ Trout Lake Natural Area Preserve - WA State		483 (2005) 349 (2004) 479 (2003) 512 (2002, 2001) 959 (2000) 764 (1999) 856 (1998) 570 (1997)	Some private ownership lands adjacent to NAP that could be developed
▪ Trout Lake Creek Beaver		85 (2005) 60 (2003)	

Ponds - Gifford Pinchot NF			
▪ Conboy Lake – USFWS (Conboy Lake NWR) and private		3,404 (2005) 3,898 (2004) 2,085 (2003) 1,442 (2002) 1,630 (2001) 4,666 (2000) 5,434 (1999) 7,018 (1998)	
Oregon – 29 sites			
Central Oregon Cascades -22 sites			
▪ Camas Prairie - Mt. Hood NF and Private	23 juv, 17 >36 mm (1996)[1]	< 30 (2004)[2]	Camas Prairie is an isolated marsh in the upper White River system (a tributary to the Deschutes River). Threats include susceptibility to drought, grazing impacts, and effects of isolation.
Mink Lake Basin consists of two sites on Willamette NF ▪ Penn Lake/Cabin Meadows site ▪ Unnamed Marsh north of Mink Lake		Average of 34 over 4 years[4] Average of 34 over 4 years[4]	Two separate breeding sites. Both sites are affected by predaceous non-native fish. Susceptible to drought, and vegetation succession. Separated from any other known occupied site.
▪ Muskrat Lake – Deschutes NF	20-40 breeding females over several surveys 2002-2004[2]		Threats include high density of non-native predaceous fish, and fluctuating water levels. High recreational use occurs in this area.
▪ Winopee Lake & Lower and Middle Snowshoe Lakes	No survey data available		Winopee –evidence of breeding in late 1990s[2] Threats include non-native predaceous fish

– Deschutes NF			and susceptibility to drought. Because it is a shallow marsh, succession is an issue of concern. Snowshoe Lakes – adults occasionally detected, but no evidence of breeding[2].
▪ Little Cultus Lake - Deschutes NF	<30 breeding females (2005) [2] 15 larvae 2 > 51 mm (1995) [1]	<10[2]	Small population, potential impacts from non-native predaceous fish and drought.
▪ Cultus Creek Gravel Pit - Deschutes NF	No current information 9 juv, 1>36mm (1995) [1]		Threats include abundant, stocked, non-native predaceous fish
▪ Lava Lake & ▪ Hosmer Lake Both on Deschutes NF	6 larvae (1995) [1] 3 juv, 5 > 36 mm (1996)[1] 62 mostly juv (1995) [1]		Impacted by water level fluctuations and non-native predaceous fish, and drought.
▪ Little Lava Lake - Deschutes NF	10 larvae (1995) [1] 10 adults (Blue Lagoon area in mid 1990s)[3]		No recent information available
▪ Little Deschutes River/Highway 58 area - Deschutes NF	Current status unknown, only known surveys documented two adult frogs in 2001[4]		Disjunct habitat. No estimate of population size or distribution
▪ Wickiup Reservoir - Deschutes NF	Small numbers of frogs in northeastern area of reservoir. [2] 0 (1996) [1] 0 (1995) [1]	Northeast area <10 egg masses last five years[2]	Last several surveys suggest that western portion may be unoccupied. [2] Threats include fluctuating water level that vary greatly between and within years, and non-native predaceous fish. High recreational use occurs in this area. Frogs found in the ditch below the dam in

			1996[1]. This habitat no longer appears to be viable due to dam reconstruction work in 2001[2].
▪ Dilman - Deschutes NF	50 breeding females (2005) [2]		40 frogs were translocated from Wickiup ditch site to created habitat in 2001. Population has increased from 11 to 50 breeding females. [2] Habitat succession will affect longevity of the site due to pond filling in. Intervention may be necessary to keep open water. [2]
▪ Crane Prairie & Meadowlands to north of Wickiup Reservoir & Quinn River Campground - Deschutes NF	No information available on current frog populations. 1 larvae, 3 > 36 mm (1996) [1] 8 > 36 mm (1995) [1]		Population appears to have declined in last 25-30 years based on observational accounts [1, 2]. Main threat is likely non-native predaceous fish. Fluctuating water levels could also be a factor. Heavy recreational use occurs in this area.
▪ Gold Lake Bog (Research Natural Area) - Willamette NF			Threats include non-native predaceous fish and isolation.[2] Vegetation succession is a potential threat.
▪ Odell Creek/Davis Lake - Deschutes NF	Two sub-adults found near outlet of Odell Creek into Davis Lake. (2004) [4] 4 >36 mm (1994)[5]		Threats include fluctuating water levels and non-native predaceous fish. High recreational use occurs in this area. There is no riparian connection to other OSF populations.
▪ Odell Creek/NF Road 4660 -	1 adult (2004) [4] 8 >51mm (1994) [1]		Threats include, fluctuating water

Deschutes NF			levels, presence of non-native predaceous fish, limited side channels with warm water, and no apparent connection to other populations. High recreational use occurs in this area.
▪ Ranger Creek[3] - Deschutes NF	None found in 2004[4] 2 > 66 mm (1994)[5]		Fluctuating water level likely reduces frog habitat. Other limitations include very cold water[4]. Threats include predaceous non-native fish [2]. High recreational use occurs in this area. There is no riparian connection to other spotted frog populations[4.] Davis fire of 2003 impacted this area, riparian associated shrubs are responding well after fire[4].
▪ La Pine/Long Prairie - BLM[1] private	1 dead ad (2005)[6] 2 ad, 1 juv (2003)[6] 1 juv (2002) [4] 0 (2001)[6] 2 ad,1 larvae (2000) [6] 2 ad (1998) [6] 9 larvae, 42 >36mm (1996) [6]	0 (2005) [6] 12 (2003) [4] 20 (2001) [6] 14 (2000) [6]	Site is connected to known Oregon spotted frog populations down stream. Threats include bullfrogs in La Pine area
▪ Little Deschutes River - BLM[1] (includes Casey Tract and barrow ditch) and private	4 ad, 3 juv (2005) [6] 0 (2003) [6] 8 juv. (2003) [6 Crescent Ck] 1 ad,1 sub-ad (2002) [6] 0 ad, 120 larvae (2001) [6] 2 ad, 39 juv (2000) [6]	9 (2005) [6] 56 (2005) [6 Crescent Ck] 6 (2003) [6] 34 (2003) [6 Crescent Ck] 11 (2002) [6] 293+ (2001) [6]	Threats include bullfrogs, drought, and lack of water in oxbows. No survey data for private lands

	0 ad,100 juv (1999) [6] 3 ad, 5 juv. (1998) [6] 2 subad, 2 juv (1997) [6] 1 ad (1995) [6] 5 ad (1994) [6] 8 ad (1994) [6] Crescent Ck	27 (2000) [6] 8 (1999) [6]	
▪ Sunriver Nature Center[2] - Private	294 ad, 111 juv (2005)[7] 429 ad, 68 juv (2004) [7] 470 ad, 211 juv (2003) [7] 45 ad, 142 juv (2002) [7] 163 ad, 49 juv (2001) [7] 497 ad, 49 juv (2000) [7] 796 ad, 340 juv (1999) [7] All data based on fall movement data	637 (2005) [7] 357 (2004) [7] 477 (2003) [7] 698 (2002) [7] 1182 (2001) [7] 619 (2000) [7]	Threats include non-native predaceous fish, and bullfrogs. In 2000 and 2001 weirs that helped maintain water levels in the entire lake/marsh system failed leading to a sudden drop in water level that affected reproduction. [7] It is unknown why survey numbers have not returned to the higher numbers of 1999. [7]
▪ Big Marsh[3] – Deschutes NF	147 (1999)* 293 (1997)* 27 larvae, 203 juv, 79>36 mm (1994) [1] *Adult and juvenile survey	1,254 (2005)** 189(2004)*** 694 (2003) 490 (2002) 230 (2001) 80 (1998) **Incomplete survey on east side ***Incomplete survey, too late in season	Big Marsh (2,000 ac) was historically ditched to increase grazing area. Deschutes NF has initiated restoration to return the marsh to historical conditions. Invasive reed canarygrass is present, and lodgepole pine encroachment is a concern. Seasonal water fluctuations have impacted egg mass survival
Klamath Basin:			
▪ Klamath Marsh NWR – USFWS and private lands	*52 (2001) 19 (2000) *50 adults collected for deformity study	30 (2005) 3 (2004) 4 (2003) 142 (2002) 189 (2001) 191 (2000)	Adults, juveniles and metamorphs were documented at 46 of 95 surveyed sites Threats include non-native predaceous fish.
▪ Wood River		75 (2002)	2000 survey was brief

Wetlands – BLM and private land		171 (2000) In 2002, an additional 23 egg masses were found upstream from the BLM lands	but documented frogs at different locations. Threats include non-native predaceous fish.
▪ Fourmile Creek/Springs, Crystal Spring, Sevenmile Creek Crane Creek – Private, BLM, and NF	0 (2005) 19 (2000) Spotted frogs documented at Crane Creek. Crystal Spring was searched but NO frogs were seen in 2000. Present (1996, 1997)		Most of the surveys have been done on Fourmile Creek. Apparently suitable, unsurveyed habitat also exists on private land near Fourmile Creek This population may have been historically connected with the Wood River population Threats include non-native predaceous fish.
▪ Buck Lake – Private, BLM, and NF	0 (2005)		Marc Hayes population estimate of about 400 (1995-1996). Most (90%) of the habitat is private 20 miles to nearest Oregon spotted frog population. Threats include non-native predaceous fish, exotic vegetation encroachment, and vegetation succession.
▪ Jack Creek – Private and NF	Little or no recruitment in 2004 and 2005 11 (2005) 25 (2004) 41 (2003) 33 (2002)	No egg mass surveys in 2004-2005 71 (2003) 60 (2002) 167 (2001)	Decline in egg masses in 2002 may be attributed to drought. >6.0 miles to nearest Oregon spotted frog population.

	111 (2001) xx (2000) 82 (1999) Population estimate of 300 – 1,000 adults in 1999.	320 (2000) 335 (1999)	Threats include exotic vegetation encroachment, and vegetation succession.
▪ Upper Williamson River –Private and NF	12 (2000)	0 (2005) 0 (2004)	Severely low water levels in 2005 dried oxbows, sloughs and marshes, effectively eliminating breeding habitat (T. Simpson, pers. comm.). Egg mass surveys conducted south of Rocky Ford. Threats include non-native predaceous fish.
▪ Parsnip Lakes vicinity - Medford BLM	< 20 breeding females[2]	<20[2]	Small shallow site. Habitat affected by grazing, OHVs, and sediment run-off.

[1] Prineville District Record, Bureau of Land Management
[2] Bowerman Survey Data
[3] Crescent Ranger District Record, U.S. Forest Service
[4] C. Pearl, pers. comm. 2006
[5] Hayes (1995)
[6] Hayes (1997)
[7] Sandra Ackley, USFWS, pers.comm. 2005

Egg mass counts are believed to be a good metric of adult population size and are the most time-efficient way to estimate population size (C. Pearl, pers. comm. 2006). Adult females lay one egg mass per year and the breeding period occurs within a reliable and predictable time frame each year (K. McAllister, pers. comm. 2006). Egg mass numbers represent a single survey timed to coincide with the end of the breeding season. The rule of thumb for estimating population size is that 1 egg mass is equivalent to 1 breeding female plus 1-2 adult males (C. Pearl, pers. comm. 2006). Two weaknesses of using egg mass counts to estimate population size are the uncertainty whether adult females breed every year, and the difficulty of distinguishing individual egg masses in large communal clusters. However, the method for counting individual egg masses in communal masses was standardized in 2003 (Lisa Hallock, WADNR, pers. comm. 2006). Because of these weaknesses, population estimates derived from egg mass counts are considered to be a minimum population estimate.

Washington

In the State of Washington, the distribution of Oregon spotted frogs has declined dramatically due to filling and alteration of wetlands (see Threats section). Oregon spotted frogs are only known to occur within the Black River drainage (4 populations), Trout Lake Creek (2 populations), and at Conboy Lake. These seven Oregon spotted frog populations are isolated from each other and vulnerable to a wide variety of factors that might interfere with reproduction or survival.

Beaver Creek

The Beaver Creek site is a complex of emergent marsh, stream, beaver pond, drainage ditch, and riparian habitat (McAllister and White 2001). The wetlands occur on property known as the old Pacific Powder site, formerly an explosives manufacturing site which is currently owned by Citifor Corporation. Egg mass counts at Beaver Creek totaled 107 in 2000 (White 2002) and 58 in 2001 (McAllister and White 2001). Egg masses were found at 11 locations within the complex, but 2 of the locations accounted for 59 percent of all the egg masses located in 2001. One of these locations was a vegetation treatment circle where all of the vegetation had been removed in late summer. The other was in tire tracks of a vehicle that had driven through the wetland prior to the 2000 breeding season, flattening the reed canarygrass and exposing shallow, open water (McAllister and White 2001).

Dempsey Creek

Oregon spotted frogs inhabit the Dempsey Creek wetlands along most of the creek's length, all of the way to the mouth of the creek at the Black River. They also inhabit the margins of the Black River upstream and downstream of the mouth of Dempsey Creek. This site occurs entirely on private lands, including the Wilson Dairy and Port Blakely Tree Farm. Oregon spotted frog population monitoring has been ongoing at this site since 1996 and indicates this population contains several hundred breeding adults (Watson et al. 2000, McAllister et al. 2004).

110th and 123rd Avenues

In 2001, two new breeding sites were located along the Black River downstream of Dempsey Creek (McAllister and Walker 2003). While there is an aquatic corridor to connect these two sites to the Dempsey Creek site, there are lengthy segments unsuitable for prolonged occupation by Oregon spotted frogs. The conclusion reached by McAllister et al. (2004) is that movement of frogs between the Dempsey Creek, 110th Avenue, and 123rd Avenue populations does not occur or occurs so infrequently as to be an insignificant factor in the population dynamics at any of the three sites; therefore, the three sites comprise separate and distinct populations. The 110th Avenue population is small with only 1 egg mass seen in 2004 (McAllister et al. 2004) and 1 in 2005 (K. McAllister pers. comm. 2006). The 123rd Avenue site supports at least 125 adult frogs (McAllister et al. 2004). A more precise population estimate is not available because the 2004 study focused on processing frogs in traps and time was not devoted to assessing the numbers of egg masses in large communal aggregations (McAllister et al. 2004). All of the Oregon spotted frog habitat associated with the 110th Avenue site and most (perhaps all) of the habitat associated with the 123rd Avenue site is within the Black River Unit of the Nisqually NWR.

Trout Lake Natural Area Preserve

The Trout Lake NAP site is part of a large (>1,000 acre) wetland and riparian system that contains large expanses of emergent and scrub-shrub wetlands and riparian forest associated with

Trout Lake Creek (Leonard 1997). There are four main breeding areas within the NAP. Surveys for additional breeding areas have been conducted in the northern and southern areas of the wetland, with negative results. Surveys along Trout Lake Creek located a small number of egg masses and additional surveys along the creek are planned for 2006. Egg mass counts have been conducted annually since 1997. Since 1999, surveys have been organized and conducted under the guidance of the same person (L. Hallock, pers comm. 2006). The highest number of egg masses was recorded in 1999 (959 egg masses), the lowest in 2004 (349 egg masses). In 2005 483 egg masses were counted. Within the Trout Lake Creek system, no flow diversions are present upstream of the NAP; therefore, the variation observed in the number of egg masses is most likely natural. For example, in 2003, due to snowmelt and rain, water levels rose and receded dramatically at one site after egg masses had been laid. Almost all the egg masses were stranded on dry land far from water, resulting in little or no recruitment at that site that year (L. Hallock, pers comm. 2006).

Trout Lake Creek Beaver Ponds

The Trout Lake Creek beaver ponds are located within the Gifford-Pinchot National Forest, along an unnamed tributary of Trout Lake Creek. This site is approximately 10 acres in size and is formed by a series of beaver dams across the unnamed tributary (Leonard 1997). Egg mass counts have been sporadic at this site, but counts in 2005 yielded 85 egg masses. This site is matrix lands under the Northwest Forest Plan and is managed as deer and elk winter range and a roaded natural area. Therefore, development for additional recreational use could occur, but none is currently proposed. The lands upstream of the beaver ponds is managed for timber. This site may be connected to the Trout Lake NAP site; however, further investigation is required.

Conboy Lake

At Conboy Lake NWR, Oregon spotted frog egg mass surveys suggest a continued long-term decline since 1998 when 7,018 egg masses were counted. The Oregon spotted frog population at Conboy Lake NWR declined over 80 percent between 1998 and 2002 Although preliminary data indicates an annual egg mass hatch rate of over 90 percent from 2002 through 2005 (J. Engler, pers. comm. 2006), this population continues to decline. Despite the apparent success of restoration activities at Conboy Lake NWR (see Conservation Measures Planned or Implemented), the vast majority of the refuge and adjacent private wetlands have nonviable subpopulations of Oregon spotted frogs, some having disappeared from these habitats since 1998.

Oregon

In the State of Oregon the Oregon spotted frog is presently only known to be extant within the Central Oregon Cascades and the Klamath basin. No connections are known to exist between these two geographic areas and they are considered to be isolated from one another. In the Central Oregon Cascades the Oregon spotted frog is found within the Deschutes Basin and the Willamette drainage. Hayes (1997) found that in the Deschutes Basin the range of the Oregon spotted frog has been substantially reduced. Twenty-one of the 22 Central Oregon Cascades sites (excluding the outlier occurrence at the Camas Prairie site) are clustered primarily on the east flank of the Cascade Mountains (Mink Lake Basin sites and Gold Lake Bog site occur just across the divide on the west side of the Cascade crest). This area extends from Big Marsh to the

south, Hosmer Lake to the north, the Mink Lake Basin sites and Gold Lake Bog just across the divide to the west, and the Deschutes and Little Deschutes River occurrences to the east. Although complete surveys across this entire area have not occurred, surveys of other apparently suitable habitat within this area have not found any new occurrences of Oregon spotted frog. The specific microhabitat requirements of the Oregon spotted frog appear to result in use of only a subset of available aquatic habitat (Pearl and Hayes 2004).

The 22 sites in the Central Oregon Cascades are contained within a roughly triangular area of approximately 731 square miles in the upper Deschutes and Willamette Basins (C. Pearl, pers. comm. 2006). Thus, the majority of the known sites occur in a very small segment of the historic Oregon spotted frog range.

Although there are not specific population estimates, survey data indicate that Big Marsh and Sunriver are the largest populations in the Central Oregon Cascades (see Table 1) with consistent survey information. Survey data for Little Deschutes River sites provide highly variable egg mass counts. Based on limited survey data, 19 sites are estimated to have relatively small populations. Observations and survey information for nine of the sites (Little Deschutes River/Highway 58 area, Ranger Creek, Odell Creek/Forest Road 4660, Odell Creek/Davis Lake, Wickiup Reservoir, Crane Prairie and Meadowlands, Little Lava Lake, Lava Lake/Hosmer Lake, and Cultus Creek gravel pit) indicate that less than 10 adults or egg masses have been observed. Seven sites are estimated to fall within the <30-50 range for breeding females or egg masses (La Pine/Long Prairie 12-20 egg masses, Dilman - 50 breeding females, Little Cultus Lake - <30 breeding females, Muskrat Lake - 20-40 breeding females, Mink Lake Basin (Penn Lake sites)- average of 34 egg masses over 4 years of survey, and Camas Prairie - <30 breeding females (C. Pearl, pers. comm. 2006). No survey data were available for Gold Lake Bog, Winopee Lake and Lower and Middle Snowshoe Lakes.

Central Oregon Cascades (22 sites)

Camas Prairie

Camas Prairie is a 33-ha marsh site located in the White River system in the Deschutes drainage. The Camas Prairie has an isolated small population thought to be especially distinct because frogs from this population have low genetic diversity and carry several alleles that are absent or rare in other Oregon spotted frog populations in Oregon and Washington (Blouin 2000). Table 1 shows the available population information.

Lakes north of Crane Prairie

The scattered lakes north of Crane Prairie include Little Cultus Lake, Cultus Creek gravel pit, Muskrat Lake, Winopee Lake, Lower and Middle Snowshoe Lakes, Mink Lake Basin (Penn Lake/Cabin Meadows and unnamed marsh north of Mink Lake), Lava Lake and Little Lava Lake, and Hosmer Lake). Table 1 provides survey information for these small populations.

Little Deschutes River/Highway 58 area.

This site is primarily mature lodgepole pine (Pinus contortus) and willow (Salix spp.) in the riparian zone. The only known surveys occurred in 2001, and two adult Oregon spotted frogs were observed (Crescent Ranger District Record 2005). There is no current estimate of

population size.

Wickiup Reservoir area
Wickiup Reservoir has a small number of frogs in the northeastern area of the reservoir, with less than 10 egg masses observed in surveys over a 5 year period (C. Pearl, pers. comm. 2006). The last several surveys suggest that the western portion of Wickiup Reservoir may be unoccupied (C. Pearl, pers. comm. 2006). Surveys by Hayes in 1995 and 1996 did not find any Oregon spotted frogs (Hayes 1997).

A small Oregon spotted frog population (40 frogs) on Bureau of Reclamation land at the base of Wickiup Dam was translocated to six constructed ponds in nearby Dilman meadow on the Deschutes National Forest (C. Pearl and J. Bowerman, pers. comm. 2005). The original population produced 11 and 9 egg masses in the 2 years prior to translocation. The ditch site at the base of the dam no longer appears to be viable habitat due to dam reconstruction work in 2001. The Dilman population has increased steadily since the move and produced 49 egg masses in 2005. However, some ponds are losing open water to vegetation encroachment, and site maintenance is likely to be necessary in the future.

No recent information regarding the Crane Prairie and Meadowlands to the north of Wickiup Reservoir and Quinn River Campground was found. Table 1 provides information on results of 1995 and 1996 surveys by Hayes.

Gold Lake Bog
Gold Lake Bog is located on the upstream end of Gold Lake on the Willamette National Forest on the 188-ha Gold Lake Bog Research Natural Area. The Gold Lake Bog site consists of three small ponds (totaling 1.5 ha) within a larger bog where three major streams converge and flow through the bog. This area is considered to have a stable population based on periodic monitoring by USGS and the Willamette National Forest. Oregon spotted frogs have been collected at this site in 1961, 1966, 1982, and 1984. In 1991, juvenile spotted frogs were observed near the Salt Creek outflow of Gold Lake, which is at the opposite end of the historic locality (Hayes 1994). Specific survey information was not available at the time of writing this report.

Davis Lake area (3 sites)
The Davis Lake area supports three known occupied sites of Oregon spotted frog at the confluence of Odell Creek and Davis Lake, Odell Creek at Forest Service Road 4660, and Ranger Creek. The vegetation was predominantly mature lodgepole pine forest. However, in 2003 the Davis fire burned through these areas, killing much of the lodgepole pine. Riparian associated shrubs are responding well after the fire along Odell and Ranger Creeks (Crescent Ranger District Record 08.2.2005). Hayes and Crescent Ranger District staff found small numbers of Oregon spotted frog at these three sites in 1994. Surveys contracted by the Forest Service confirmed occupation at Odell Creek Forest Service Road 4660. However no frogs were found at Ranger Creek in 2004. Fluctuating water levels may affect Oregon spotted frog occupancy at Davis Lake. There is no estimate of the Oregon spotted frog population in the Davis Lake/Odell Creek sites. No riparian connection exists to other known Oregon spotted frog sites.

Deschutes River and Little Deschutes River (3 sites)
Three known occupied sites occur along the Deschutes River and the Little Deschutes River (and its tributary Long Prairie) east of Wickiup Reservoir including the sites referred to as La Pine/Long Prairie, Little Deschutes River BLM, and Sunriver. The La Pine/Long Prairie and Little Deschutes River sites are managed by BLM and consist of lodgepole pine forest and a sedge meadow/marsh and riparian corridor complex. Privately owned land is intermixed among BLM managed lands. Survey data exists over the BLM portion of this site (see Table 1). In 2001, 20 egg masses were observed but no egg masses were found in 2005 in surveys conducted by BLM in the La Pine/Long Prairie site. This site is connected to populations of Oregon spotted frog downstream. Survey data for the Little Deschutes River is shown in Table 1. Egg mass numbers since 1999 are generally low. However, 2001 is of particular note; surveys conducted in 2001 found 293 egg masses clustered over a relatively small area due to a limited amount of available water in this dry year. A follow up survey documented the loss of virtually all of these egg masses due to desiccation as the water dried up. There are no survey data for the private lands in this area.

Sunriver
The Sunriver site consists of an extensive complex of wetland habitat ranging from wet meadows and vernal pools to marshes and oxbows (Bowerman and Flowerree 2000). Surveys of known and suspected Oregon spotted frog habitat were conducted in 1999 in the Sunriver area along the Deschutes and Little Deschutes Rivers from Sunriver south to LaPine. This survey was largely qualitative, noting presence and absence, while documenting 400 to 700 egg masses from 2 locations and an additional 100 egg masses widely scattered along a 3 km waterway that extends between these two major oviposition sites (Bowerman and Flowerree 2000). Subsequent surveys conducted by Bowerman (see Table 1) utilized a fall capture and spring movement methodology, as well as surveying for egg masses (J. Bowerman, pers. comm. 2006). Fall/spring movement data represent the frogs captured moving through a major over-wintering site to a major breeding and foraging site and returning**.** This information does not represent all survey information, but has been consistently collected from 1999 through 2005. As mentioned in Table 1, for two consecutive years (2000 and 2001) two weirs alternately failed, leading to a sudden drop in water levels in the middle of fall migration and the breeding season respectively. This led to low recruitment as can be seen in the survey numbers in the Fall of 2001 (J. Bowerman, email comm. 2006). The data indicate that overall numbers have declined steadily during the survey time frame and have not returned to the high numbers observed in 1999.

Big Marsh
Big Marsh is a 2,000-acre high elevation wet meadow and marsh complex managed by the Deschutes National Forest. The marsh is dominated by several sedge species. Historically the marsh was privately owned and was ditched to maximize forage production.

Sporadic surveys for Oregon spotted frogs at Big Marsh on the Deschutes National Forest have been conducted between 1994 and 2005. Hayes surveyed the site in 1994 and the Forest Service has conducted surveys annually since 2001. The results of these surveys are shown in Table 1. Egg mass surveys conducted in 2001 documented 186 egg masses on the east ditch and two portions of the west ditch, and a total of 230 egg masses. Egg mass surveys conducted in 2002

documented 490 egg masses at 50 sites on 700 acres (Kittrell 2002). The 2003 survey documented 694 egg masses at Big Marsh (J. Kittrell, pers. comm. 2004). Another small population on the Little Deschutes River had 10 egg masses in 2003 (J. Kittrell, pers. comm. 2004). The 2004 and 2005 surveys documented 189 and 1,254 egg masses respectively (Crescent Ranger District Record 2005). However, seasonal water fluctuations have impacted egg mass survival (Crescent Ranger District Unpublished Report, 08.22.2005).

Klamath Basin (8 sites)

Surveys for Oregon spotted frogs and egg masses have been conducted in the Klamath Basin of Oregon since 1994. Eight Oregon spotted frog sites have been located to date. Although most surveys occurred on public land, some surveys on private land were also done (Ross 2000a,b,c,d,e; Ross and Mauser 2000; Ross and Watkins 2000).

Klamath Basin data suggests that three populations (Jack Creek, Klamath Marsh NWR and Buck Lake) have declined since 2000, one population (Wood River) appears stable, and four sites do not have enough data to determine trend. The Jack Creek and Buck Lake sites are not connected hydrologically to any other Oregon spotted frog populations and would require overland movement of miles to reach another population. These populations can be considered isolated from other Oregon spotted frogs with a very low chance of genetic interchange or re-colonization. The rest of the known Klamath Basin populations are connected hydrologically to another population with some opportunity for genetic interchange or re-colonization.

Extensive Oregon spotted frog surveys to locate additional Oregon spotted frog populations were conducted in the Klamath Basin between 18 July and 14 September, 2005 by Forest Service biologists and technicians with spotted frog experience. Crews consisted of 2 to 6 surveyors, depending on availability and complexity of habitats to survey. Twenty-eight different sites in Lake, Klamath and Jackson Counties were surveyed on the Fremont-Winema National Forest, BLM (Lakeview and Ashland Resource Areas), Bureau of Reclamation, and private land. Survey effort comprised over 300 man-hours and no Oregon spotted frogs were found (Oertley 2005).

Klamath Marsh NWR

The 40,646-acre Klamath Marsh NWR is a large natural marsh along the upper portion of the Williamson River managed primarily for waterfowl and wetland habitat. The marsh is supported by a series of springs that provide permanent water. Along the west and east sides, the Klamath Marsh NWR is surrounded primarily by private grazing lands. The Fremont Winema National Forest abuts the marsh on the north and south sides.

Surveys at Klamath Marsh NWR in 2000 documented 191 Oregon spotted frog egg masses at 27 sites with no egg masses recorded at eight sites on the Klamath Marsh NWR (Ross and Mauser 2000). Surveys in 2000 for adults, juveniles, and metamorphs documented Oregon spotted frogs at 46 of 95 sites surveyed in two general areas of the refuge: Big Springs Creek and the eastern portion east of Military Crossing. Tadpoles were documented at eight sites, although adults were the focus of the surveys (Ross et al. 2000). After 2000, surveys found 189 egg masses in 2001, 142 egg masses in 2002, 4 egg masses in 2003, 3 egg masses in 2004, and 30 egg masses in

2005. Survey efforts varied from year to year, but Klamath Marsh NWR staff believe the population has declined (Dave Mauser, USFWS, pers. comm. 2006).

Wood River

Oregon spotted frogs were discovered about 2 miles upstream of the mouth of Wood River in 1994 on a 2,800-acre parcel known locally as the Wood River Wetland. This site used to be managed as a private cattle ranch, but is currently managed as a wetland by the BLM Klamath Falls Resource Area. Surveys were conducted in 1994 and 1995 to determine the extent of the Wood River spotted frog population (Hayes 1994). Surveys in 1997-98 resulted in an encounter rate almost double the 1994 – 1995 surveys (Hayes 1998d). There was also a change in demography from predominately juveniles to predominantly adults and sub-adults.

Egg mass surveys were conducted each spring from 1999 through 2005, although survey effort, locations and results varied. Between 1999 and 2004, egg mass surveys documented 83 to 171 egg masses per year. Surveys of the Wood River Wetland in 2000 documented 171 egg masses at 26 sites (1 to 29 egg masses/site) along the Wood River Ditch, a small parallel ditch, and 3 sites in a pond (Ross and Watkins 2000). Surveys in 2002 found 75 egg masses (Wedge Watkins, BLM, pers. comm. 2002). In 2002, an additional 23 egg masses were found approximately four miles upstream from the the known population on BLM lands (David Ross, USFWS, pers. comm. 2002). It is unknown whether this represents a new population or an extension of the known population. The Oregon spotted frogs on the Wood River Wetland appear to be adjusting to shifts in the hydrologic regime and vegetation (BLM 1998; Rob Roninger, BLM, pers comm. 2005).

Fourmile Creek, etc. complex

The Fourmile Creek, Fourmile Spring, Crystal Spring, Sevenmile Creek, Crane Creek complex(es) include a large amount of potential Oregon spotted frog habitat. In 1996 and 1997, fieldwork completed by Marc Hayes determined that Oregon spotted frogs were broadly distributed in the Fourmile Springs and Fourmile Creek areas. This habitat may have been historically connected with the Wood River habitat, though the populations may be currently isolated by the Sevenmile Canal and intervening inhospitable habitat.

Surveys along a portion of Fourmile Creek in 2000 documented 19 Oregon spotted frogs (Ross 2000a). Most were observed in the margins and channels associated with beaver ponds. No juvenile or adult Oregon spotted frogs, and only two unidentified tadpoles, were located in surveys of two lateral ditches where a number of Oregon spotted frogs were previously located by Hayes (1998c). Hayes (1998c) documented Oregon spotted frogs at three other sites along Fourmile Creek. Ross (2000a,b) also documented an Oregon spotted frog population on private land along Crane and Sevenmile Creeks about 3.5 kilometers (km) (2.2 miles (mi)) north of Fourmile Creek. Potential habitat near Crystal Spring was searched but no frogs were seen during the August 2000 surveys (Ross 2000). Surveys in 2005 found no Oregon spotted frogs in Crane Creek nor in the land adjacent to Sevenmile Creek, which was private at the time, but which has since been bought by the Bureau of Reclamation (Oertley 2005).

Buck Lake

Buck Lake is located approximately 21 miles west of Klamath Falls and 6 miles south of Lake of

the Woods. This site is at least 20 miles from any of the other known spotted frog populations in the Klamath Basin. Buck Lake is actually a meadow with drainage ditches, many springs, two creeks (Tunnel Creek and Spencer Creek) flowing through it. Most of the historic lake (over 90%) is in private ownership, and has been managed in various ways, most recently for cattle grazing. Portions of Buck Lake are administered by the BLM and the Fremont-Winema National Forest. Some of the frog habitat has been fenced to exclude livestock.

In 1995 and 1996, Marc Hayes initiated a mark-recapture study in Buck Lake, which resulted in a population estimate of about 400 adults (Hayes 1996). Demographic information from this study showed limited evidence of recruitment even though there was high water availability during these wet years. Hayes attributed this lack of substantial recruitment to the presence of resident brook trout (Salvelinus fontinalis) Surveys in 2001 located about 15 adults and one tadpole (Ross 2001). No adults were located in a 2005 survey (Oertley 2005).

Jack Creek

The Jack Creek Oregon spotted frog population was discovered in 1996 on the Chemult Ranger District, Winema National Forest. This was verified as the highest elevation extant population (5,440 feet) of Oregon spotted frogs. The habitat consists of low gradient stream segments that flow through a series of montane meadows, with deep pools that may be a result of beaver activity.

From 1997 to 2002 a mark-recapture program was conducted in all occupied habitat at Jack Creek, including the private lands, to estimate approximate population size. In 1998, although egg masses were not found, breeding did take place and many young frogs were produced (Forbes and Peterson 1999). From 1999 to 2003, spring egg mass surveys were done to determine the number of adult breeding females. Egg mass monitoring results suggest that the spotted frog population is declining: numbers of breeding females were estimated to be over 330 during the first 2 years, dropping to half (167) in 2001. In 2002, 60 egg masses (half of which were partly dead) were counted, increasing to 71 egg masses in 2003. Egg mass counts post-2003 were discontinued because access to the private property where most of the breeding habitat occurs was denied (J. Oertley, pers. comm. 2005).

Numbers of adult Oregon spotted frogs appeared to be lower in comparison with other Oregon spotted frog populations in the Klamath Basin (Hayes 1996). The low numbers may be due to the elevation and temperature limitations of the Jack Creek site (Hayes 1998a). The 1999 population estimates for the number of adults in Jack Creek ranged from about 300 to about 1,000 Oregon spotted frogs (Forbes and Peterson 1999). However, it appears the number of adults is declining and there was little or no recruitment in 2004 and 2005 (J. Oertley, pers. comm. 2005).

The Jack Creek population was severely impacted by low water levels and drought in 2001 and 2002. Previous egg-laying habitat, at edges of snow melt along the Jack Creek floodplain, was not present due to low snowpack in 2003 and 2004. The egg-laying sites shifted to localized areas in several inches of standing or flowing water, including water-filled livestock trails, where they had not been observed in previous spring surveys. These trails were very ephemeral sources of water and most likely dried up before eggs could hatch or tadpoles could swim to

perennial water sources (J. Oertley, pers. comm. 2005).

Upper Williamson River

Above the Klamath Marsh NWR, the Williamson River has oxbows, spring fed sloughs, marshes, and ditches that provide suitable Oregon spotted frog habitat. The river in this area connects with the NWR during high runoff events. In 2000, 12 adult frogs were found along sections of the Upper Williamson River between Rocky Ford and the Klamath Marsh NWR, approximately 16 km (10 mi) upstream from Klamath Marsh NWR (Ross 2000c). During 2004 and 2005, egg mass surveys were conducted south of Rocky Ford although no egg masses were found (Dave Ross, USFWS, pers. comm. 2005). Adult surveys of this area in 2005 found no Oregon spotted frogs (Oertley 2005). Severely low water levels in 2005 dried oxbows, sloughs and marshes, effectively eliminating breeding habitat (T. Simpson, USFS, pers. comm. 2005).

Parsnips Lake vicinity

In 2003, Dr. Michael Parker and his herpetology students discovered egg masses in the vicinity of Parsnip Lakes in Jackson County, Oregon (Michael Parker, Southern Oregon University, pers. comm. 2005). Subsequent surveys have confirmed the existence of a small number of adults, probably less than 20 breeding females. The site is primarily wetlands and beaver-created ponds within the floodplain of a small stream. The lakes and ponds are shallow, less than 1.5 m (about 4.5 feet) and may be affected by winter freezes at this elevation (4,300-4,600 feet). Threats to the population include cattle grazing in the vicinity, off-road vehicles driving through wetlands and stream channels, and the continued effects of past logging (increased sediment runoff) within the watershed. Neither introduced fish nor bullfrogs appear to be a problem for the Parsnip Lakes population thus far.

Summary

Some Oregon spotted frog sites in Washington and Oregon have considerable survey information, such as Big Marsh and Sunriver in Oregon and Dempsey Creek in Washington; however, most sites have limited survey information. In addition, survey methods and effort have not been consistent across both states. However, from the population information currently available, it appears that the Big Marsh, Wood River, Gold Lake Bog, Dempsey Creek, and Trout Lake NAP sites may be stable and the Klamath NWR, Jack Creek, Buck Lake, and Conboy Lake NWR sites are declining. Although the egg mass and fall movement data are inconsistent, the population at the Sunriver site is likely declining. The population status is unclear for the other Oregon spotted frog sites; however, the available survey information indicates most of these sites consist of relatively few individuals and in some cases no adults and/or egg masses were found in the most recent surveys. Being located on lands under Federal ownership or protected status, such as Trout Lake NAP does not guarantee elimination or reduction of threats for Oregon spotted frog populations, as many of these populations are continuing to decline due to the threats discussed below.

THREATS:

A. <u>The present or threatened destruction, modification, or curtailment of its habitat or range</u>.

Threats to the species' habitat include changes in hydrology due to construction of dams and alterations to seasonal flooding, introduction of exotic plant and animal species, plant successional changes, poor water quality, livestock grazing (in some circumstances), and residential and commercial development.

Habitat losses and alterations can affect amphibian species in a variety of ways, including eliminating immigration through losses of adjacent populations (see "Factor E") and effects on critical aspects of the habitat (Hayes and Jennings 1986). These critical aspects may include suitable egg-laying and nursery sites, refuges from predation or unfavorable environmental conditions, and suitable temperatures necessary for egglaying, growth, and development (Hayes and Jennings 1986).

Several aspects of the Oregon spotted frog's life history make it particularly vulnerable to habitat alterations: (1) communal egg-laying at sites used year after year restricts the number of reproductive sites; (2) the species' warmwater microhabitat requirement results in habitat overlap with introduced warmwater fish species and other warmwater fauna (e.g., bullfrogs (Rana catesbeiana)); (3) the active-season warmwater requirement limits suitable habitat in the cool climate of the Pacific Northwest; (4) the species is vulnerable to the potential loss or alteration of springs used for overwintering; and (5) the site complexity (e.g., spatial structure) for overwintering, active season, and breeding habitats is more complex than for other frog species (Hayes et al. 1997; M. Hayes, pers. comm. 2002). Breeding habitat is probably the single most important habitat component for many aquatic-breeding amphibians because amphibian embryos and larvae depend on aquatic habitats for survival (Leonard 1997).

Loss of Wetlands: Conservative estimates for Washington indicate that over 33 percent of wetlands were drained, diked, and filled between pre-settlement times and the 1980s (Canning and Stevens 1990; McAllister and Leonard 1997). Historical losses of wetland in Oregon are estimated at 38 percent (Dahl 1990; Hayes 1997; McAllister and Leonard 1997). Based on surveys of historic sites, the Oregon spotted frog is now absent from at least 76 percent of its former range. The species may be absent from as much as 90 percent of its former range because the collections of historic specimens do not adequately reflect its actual geographic and elevational range (Hayes 1997; McAllister and Leonard 1997). Losses of Oregon spotted frog habitat have been greater because of the high degree of development in the low elevations of the Puget Trough. Therefore, this species is now found in the most suitable habitat remaining in its historic range at sites having the least-altered hydrology and the fewest introduced predators (Hayes et al. 1997).

Between 1905 and the 1960's, wetlands in the Klamath Basin were reduced from approximately 350,000 acres to 75,000 acres), primarily by the creation of agricultural lands (Bureau of Reclamation 1992). Approximately 80 percent of the wetlands in the Klamath Basin had been drained, diked, and converted to agricultural use, and removed from their historical role in the landscape. The vast majority of this loss was in the southern portion of the Klamath Basin, where extensive portions of Lower Klamath and Tule lakes were converted to agricultural lands in the first half of the twentieth century. Extensive lands in the northern portion of the basin, including wetlands surrounding Upper Klamath Lake, and Sycan and Klamath marshes, have also been converted and drained for agriculture. There are no ongoing losses of wetlands in the

Klamath Basin and since 1994, approximately 15,000 acres have been restored. However, to date, Oregon spotted frogs have not been detected in the restored wetlands.

Oregon spotted frog habitat near the Conboy Lake NWR continues to be modified due to agricultural practices, diking, dredging, and water manipulation (J. Engler, pers. comm. 2006). At minimum, these practices result in seasonal loss of breeding habitat. More than half of the wetlands on the Conboy Lake NWR are jointly managed with private owners of inholdings. In addition, the Conboy Lake NWR has multiple jurisdictional sites where private landowners manage the water on the refuge (J. Engler, pers. comm. 2006). In 2006, Conboy Lake NWR expects to lose control of approximately 1,500 acres of Oregon spotted frog breeding, rearing, and summering habitat because the private owner does not want to renew a management agreement and is threatening to keep the wetlands dry (J. Engler, pers. comm. 2006).

Wetland losses are expected to continue on private lands but at much lower rates than in the past because of federal and state regulations that pertain to wetlands (see "Factor D").

Hydrological Changes: Most of the currently occupied Oregon spotted frog sites are threatened by changes in hydrology. Twenty-one of 28 (75 percent) sites surveyed have had some human-related hydrological alterations, ranging from minor changes (e.g., local ditching around springs) to substantial changes, including major modifications of historic flow patterns (Hayes 1997; Hayes et al.1997; Pearl 1999). Dams in the upper watersheds of the Willamette Valley, the Deschutes drainage, and the Puget Trough have significantly reduced the amount of shallow overflow wetland habitat historically created by natural flooding and used by this species (Hayes 1997; Hayes et al.1997; Pearl 1999). Inundation of large marsh complexes and habitat fragmentation due to the construction of reservoirs in the Cascades have also eliminated and degraded this species' habitat. To our knowledge no new dams or reservoirs are proposed that would pose a threat to the existing Oregon spotted frog populations in Oregon or Washington. However, the operation of existing dams and diversions continues to affect populations of Oregon spotted frogs due to extreme water fluctuations between and within years, resulting in inundation and dessication of suitable Oregon spotted frog habitat, and the creation and maintenance of suitable habitat for non-native predaceous fish. The altered hydrology can affect both breeding and wintering habitat (see discussion below).

Other hydrological changes result from the continuing development of homes and roads adjacent to wetlands with Oregon spotted frogs. New development introduces new impervious surfaces which increases the amplitude and frequencies of peak highs and lows in water levels, a hydrologic charasteristic that has been implicated in reduced amphibian species diversity in King County wetlands (Richter and Azous 1995)

Changing water levels at critical periods in the Oregon spotted frog's life cycle, whether natural or human-induced, can negatively affect the species. Lowered water levels expose individuals to predation by reducing cover and confining them to smaller areas where they are more vulnerable to predators (see "Factor C"). Water level reduction during the breeding season can result in the loss of the entire reproductive effort for the year due to drying out of the egg masses (see "Factor E"). Extensive egg mass stranding associated with receding water levels, both natural and human induced, has been documented at Trout Lake (Lewis et al 2001), Conboy Lake NWR

(Hayes et al. 2000), and in Oregon (Pearl and Hayes 2004).

Drought periods can result in reduced recruitment (addition of young individuals to the adult population) regionally (Hayes 1997; Pearl 1999). Several seasons of low water can eliminate populations of Oregon spotted frogs, particularly where a small isolated population occupies a limited marsh habitat that has a high abundance of aquatic predators (Pearl 1999). Excessive seasonal flooding at critical periods can result in the loss of shallow wetlands needed for egg-laying and development.

Breeding sites can be quite dynamic and significantly influenced by water conditions. At Conboy Lake NWR in 2002, most egg-laying occurred in a few wetlands considered to be core breeding sites where the refuge maintains some level of water control, thus ensuring water at least through the egg hatching stages. The remainder and bulk of the water on the refuge is controlled locally by agricultural interests with land holdings in or adjacent to the refuge. Surveys since 1998 have documented extensive annual declines in egg mass numbers due to poor water conditions on these lands. In many cases breeding frogs have disappeared from many of these agriculturally-influenced habitats due to annual recruitment failures from early water draw downs and perennially low water. Restoration activities initiated by the refuge in 1999–2001 have enabled the refuge to maintain independent water management of several wetlands, regardless of the water-related impacts of local landowners. In 2002, approximately 60 percent of all egg masses were located on wetland units that have received some level of restoration since 1999. Despite the apparent success of these restoration activities, inadequate water or poorly timed water management activities continue to be the most significant threat to Oregon spotted frog recruitment and survival in the valley (J. Engler, pers. comm. 2003) because restoration occurred on less than half of the refuge and since that time, water management on approximately 2,500 acres (nearly half of the refuge) has been altered as a response to two landowners' dissatisfaction with the refuge's water management (J. Engler, pers. comm. 2006). The impacts of these alterations are unknown at this time.

Development: Development threatens Oregon spotted frog habitat at several sites.

In Washington, counties require setbacks from wetlands, but the private lands surrounding the Oregon spotted frog populations in the Black River drainage (Thurston County) are zoned for residential development. The human populations of all counties in the Puget Sound are growing. Thurston County has the eighth largest population among Washington State's 39 counties and is is expected to exceed all other Washington counties in population growth in the next decade (WDFW 2005). Between 2000 and 2005, Thurston County's population increased by 8 percent, over half of which was a result of people moving to the area, and the real estate market has been growing at unprecendented rates over the last 2 years. The uplands surrounding Dempsey Creek Oregon spotted frog site have considerable potential for residential development. The Wilson Dairy property includes several breeding locations and is currently for sale. The FWS's appraisal of the property was too low for the owner and he has chosen to list the property with a real estate agent (K. McAllister, pers. comm. 2006). Given the location of this property in relation to the growing community of Olympia, residential housing is the likely future land use at this location.

The current landowner of the property that encompasses the Beaver Creek site in Washington is in the process of selling the property for use as a new gravel extraction operation. The wetlands within the bounds of the 1,600-acre property are on track to be purchased by the Washington Department of Fish and Wildlife. Hydrologic models indicate there should be minimal risk to the wetland from the seven deep pits that will be created by the mining. This assumption will be monitored over the next 20 years (K. McAllister, pers. comm. 2006).

Most of the habitat used by Oregon spotted frogs in the Trout Lake system is within the NAP, except for three parcels under private ownership. All three parcels are zoned residential and have various levels of development. There are no current plans for further development on these parcels (David Wilderman, WADNR, pers. comm. 2006). One of these parcels was used for breeding by a small number of Oregon spotted frogs in the past, but surveyors no longer have access to this property. There are existing developments adjacent to Oregon spotted frog habitat within the Trout Lake NAP and concerns about reduced water quality resulting from leaking septic systems; however, there is no evidence this is a problem currently (D. Wilderman, pers. comm. 2006).

Future widening of U.S. Highway 97 from Paulina Lake Road south to First Street in La Pine may remove a substantial portion of a breeding pond. The pond is small (.06 ha) and is located in an Oregon Department of Transportation right-of-way. Due to the limited size of the pond and its location within the right-of-way, widening of the road will directly impact the pond. The project is in the early stages of preparation of an environmental assessment and is anticipated to occur within the next 2 years.

Development in the Klamath Basin is continuing. The population of Klamath County increased 10.5 percent from 1990 to 2000 (U.S. Census Bureau) and new annual housings starts have more than doubled since 2000 (Klamath County). Much of the growth is outside of the city boundaries and several large residential developments are adjacent to wetlands. The Running Y Ranch has developed 3,600 acres (golf course, 100's of homes and condominiums) adjacent to Upper Klamath Lake and potential Oregon spotted frog habitat in the last 10 years and is planning to increase that in the near future (taken from several Herald and News articles).

Livestock Grazing: In several riparian zones and wetland complexes in Washington and Oregon, livestock grazing coincides with Oregon spotted frog habitat. The effects of livestock grazing vary with the site conditions, livestock numbers, and timing and intensity of grazing. Livestock graze and trample emergent and riparian vegetation, compact soil in riparian and upland areas, and introduce urine and feces to water sources (Hayes 1997; Hayes 1998a; 61 FR 25813). The resulting increases in temperature and sediment production, alterations to stream morphology, effects on prey organisms, and changes in water quality can negatively affect Oregon spotted frog habitat.

Fourteen of 28 (50 percent) sites surveyed were directly or indirectly influenced by livestock grazing (Hayes 1997; Hayes et al. 1997; Pearl 1999). Severe habitat modification has been caused by cattle at several Oregon spotted frog localities in Oregon. Large numbers of cattle at a site may negatively affect Oregon spotted frog habitat, particularly at springs that possibly are used as overwintering sites (Hayes 1997).

Livestock grazing is cited as a specific concern for Oregon spotted frogs at Jack Creek, Klamath County, Oregon (USDA 2004). The most recent work monitoring the effects of livestock grazing on Oregon spotted frogs involved grazed and ungrazed treatments at Jack Creek on the Fremont Winema National Forests in Oregon (Shovlain 2005). Shovlain's work suggests Oregon spotted frogs prefer (migrate to) ungrazed livestock exclosures as grazing pressure increases outside the exclosures. Livestock trampling and consumption likely affects the microhabitat preferred by Oregon spotted frogs by reducing emergent and riparian vegetation, which could explain Shovlain's findings. However, the frogs in Shovlain's study did not show a preference for exclosures or controls under lower grazing pressure. Therefore, a moderate degree of grazing does not appear to affect frog behavior, suggesting an intermediate level of disturbance may be conducive to Oregon spotted frog habitat use (Hayes et al. 1997, Hayes 1998a, McAllister and Leonard 1997, Watson et al. 2003).

Fencing placed at Jack Creek to protect the riparian corridor was built to accommodate crossings of native ungulates, so native grazers were not excluded there (J. Oertley, pers. comm. 2004). This fence probably was not adequate to prevent livestock from entering fenced areas in Oregon spotted frog habitat. Improvements in fence maintenance will exclude livestock from the most susceptible Oregon spotted frog areas.

Heavy grazing use by livestock occurs on Jack Creek, Buck Lake, and on the private lands on the Wood River, Williamson River, Fourmile-Crane-Sevenmile Creeks, and adjacent to Klamath Marsh NWR. The two primary breeding sites in Jack Creek occur on private land, which is grazed in combination with Forest Service allotments. Heavy grazing use occurs on these private lands and allotments. Based on Shovlain's (2005) work, it is likely this amount of grazing is degrading the quality of the Oregon spotted frog breeding habitat and reducing reproduction (see Table 1).

Cattle numbers, distribution, and time of grazing were not adjusted for drought conditions in Oregon spotted frog habitat on the Chemult Ranger District, Winema National Forest between 2001 and 2005 (J. Oertley, pers. comm. 2005). Cattle congregated in Oregon spotted frog habitat because nearly every other water source in the allotment went dry. Trampling by cattle and alterations in water quality, bank structure, and loss of protective vegetation compounded the impacts of the reductions of available habitat due to drought conditions on Oregon spotted frog reproduction (USFS unpublished data).

Conversely, moderate livestock grazing may, in some instances (e.g., Dempsey Creek in Washington) benefit the Oregon spotted frog by maintaining openings in the vegetation in highly altered wetland communities (Hayes 1997; Hayes et al. 1997; McAllister and Leonard 1997). Watson et al. (2000) found habitat at 78 percent of the Oregon spotted frog locations surveyed at the Dempsey Creek site had signs of grazing. The grazing created penetrable, open habitat that was otherwise too dense for frog use. In the recent past, it appears that grazing was beneficial to Oregon spotted frogs at the Dempsey Creek and 123rd Avenue sites, but grazing will not be continuing into the future. The Wilson Dairy at the Dempsey Creek site is for sale (see the Development section) and grazing is unlikely to continue. The 123rd Avenue site is now under the management of the Nisqually NWR and grazing no longer occurs there either. Active

management by the refuge is required to maintain the Oregon spotted frog habitat at this site, but funding is limited (Marian Bailey, USFWS, pers. comm. 2006)

Changes in Vegetation: Oregon spotted frog ovipostion sites are generally characterized by low canopy coverage and a substrate at least partially covered with the previous year's emergent herbaceous vegetation (Licht 1971, Leonard 1997, Hayes et al. 2000, Pearl and Bury 2000). Egg masses are generally found above vegetation coverage and are rarely found above open soil or rocky substrates (Hayes et al. 2000, Pearl and Bury 2000). In addition, Watson et al. (2003) found Oregon spotted frog's habitat selection during the breeding season was strongly correlated with sedge habitat at the Dempsey Creek site in Washington.

However, exotic plant invasions, such as reed canarygrass (Phalaris arundinacea), may completely change the structure of wetland environments and can create dense areas of vegetation unsuitable as Oregon spotted frog habitat (McAllister and Leonard 1997). Reed canarygrass competitively excludes other native plant species and limits the biological and habitat diversity of host wetland and riparian habitats (Antieau 1998). Reed canary grass also evapotranspirates large quantities of moisture, potentially affecting shallow groundwater hydrologic characteristics (Antieau 1998). Reed canarygrass dominates large areas at lower elevations and is apparently continuing to broaden its range to higher elevations (Hayes 1997; Hayes et al. 1997; Pearl 1999). At the Dempsey Creek site, Watson et al. (2003) compared the types and amount of habitat used by Oregon spotted frogs and found the frogs used areas of reed canarygrass less frequently than would be expected. Given this apparent avoidance of reed canarygrass, vegetation shifts to reed canary grass dominance in wetlands occupied by Oregon spotted frogs are likely impacting Oregon spotted frog breeding behavior. Studies conducted at the Beaver Creek site (White 2002) and the Conboy Lake NWR (Pearl and Hayes 2004) concluded that Oregon spotted frog breeding site quality can be improved by reducing the height of the previous years' emergent vegetation (reed canary grass in these cases). However, at both sites, the improvement in the habitat for Oregon spotted frog breeding was only retained if the vegetation management continued. Reed canary grass is colonizing portions of Big Marsh and has also been found at the Wickiup Reservoir, Jack Creek, and Buck Lake sites in Oregon.

Loss of natural processes has also resulted in degradation of Oregon spotted frog habitat. Historically, a number of forces created early successional conditions favorable to Oregon spotted frogs in wetlands: (1) rivers meandered over their floodplains, taking out trees and shrubs and baring patches of mineral soil; (2) beavers felled trees and woody shrubs, trampled shoreline vegetation, and dragged limbs and logs through shallows; and (3) fires in summer burned areas that would be shallow water wetlands during the Oregon spotted frog breeding season in February and March. Today, all of these forces are greatly reduced as a result of human activities, including water level management from operation of dams, fire suppression and beaver removal. In addition, the current wetland management paradigm is generally a hands-off approach that results in a succession to a tree and shrub dominated community that is unsuitable for Oregon spotted frog breeding. Plant succession may be a negative factor at almost all Oregon spotted frog sites, particularly where marsh-to-meadow changes are occurring (Hayes 1997). Pearl (1999) suggested reproductive sites in lake basins with a variety of aquatic habitats available only exist within a narrow successional window, although a broader range of habitat types is used by adults in the nonbreeding season. As marsh size decreases due to plant

succession, shallow warmwater sites required by this species are lost to increased shading by woody vegetation (Pearl 1999). Recent succession-related losses of Oregon spotted frog habitat apparently have been considerably greater than succession-related habitat gains (Hayes 1997; Hayes et al. 1997). Such succession-related losses may be accelerated by human activities, such as livestock grazing, hydrology alteration, suppression of fire, beaver removal, and development.

Summary of habitat or range destruction, modification, or curtailment: Past human actions have destroyed, modified, and curtailed the range and habitat available for the Oregon spotted frog, which is now absent from at least 76 percent of its former range. Wetlands continue to be modified by agricultural and water manipulation in Washington. Operation of existing dams continues to impact Oregon spotted frogs through inundation, dessication, and creation of habitat for non-native predaceous species. New residential and road developments adjacent to wetlands continue to modify the hydrology. The timing and intensity of livestock grazing, or lack thereof, continues to reduce the quality of Oregon spotted frog breeding habitat in both Oregon and Washington. And last, but not least, exotic plant invasions and plant succession continues to modify and reduce the amount and quality of both breeding and overwintering habitat available to Oregon spotted frogs.

B. Overutilization for commercial, recreational, scientific, or educational purposes.

Intentional collection of Oregon spotted frogs and vandalism of their habitat are not presently known to be a problem.

C. Disease or predation.

Most Oregon spotted frog populations are small, and small populations already stressed by other factors, such as drought or low food availability, are more vulnerable to random, naturally occurring events (see "Factor E"). Amphibians are affected by a variety of diseases, and some diseases are known to negatively affect declining amphibian species. Diseases that are currently known to occur in Oregon spotted frogs and have the potential to affect populations are briefly discussed below.

Disease: The specific effects of disease and parasitism on Oregon spotted frogs are not well-documented. Red-leg syndrome has been identified in several declining amphibian species but is not known to be a significant problem for the Oregon spotted frog (Andrew Blaustein, Oregon State University, pers. comm. 1999).

The oomycete water mold Saprolegnia has been suggested as one of the causes of amphibian declines in the Pacific Northwest. McAllister and Leonard (1997) reported destruction of developing Oregon spotted frog egg masses by this fungus. Saprolegnia was documented on Oregon spotted frog eggs by using DNA analysis (C. Pearl, pers. comm. 2003). A non-Saprolegnia oomycete has also been confirmed on Oregon spotted frog eggs (C. Pearl, pers. comm. 2004). It is unclear what threat Saprolegnia may present to Oregon spotted frog populations, but it has been shown to destroy Oregon spotted frog egg masses and could pose a threat to individual Oregon spotted frog sites.

Chytrid fungus (Batrachochytrium dendrobatidis) has been implicated in the decline and extinction of numerous amphibian species in multiple locations around the world (Speare and Berger 2004). In the United States, 7 families including 18 amphibian species have been diagnosed as infected with chytrid fungus, including 7 ranid frogs (Speare and Berger 2004). Chytrid fungus infection has been documented in at least 10 amphibian species in the United States (USGS 2001). Chytridiomycosis is a cutaneous infection that "results in a severe diffuse dermatitis characterized by epidermal hyperplasia, hyperkeratosis, and variable degrees of cutaneous ulceration and hyperemia" (Bradley et al. 2002). Clinical signs can include lethargy, abnormal posture, loss of the righting reflex, and death (Daszak et al. 1999). The fungal organism is likely transmitted by release of zoospores into the water that eventually contact a susceptible animal, penetrating the skin, and establishing an infection (Bradley et al. 2002). Dermal infections by chytrid fungus are thought to cause mortality by interfering with skin functions, including maintaining fluid and electrolyte homeostasis, respiration, and the skin's role as a barrier to toxic and infectious agents (Bradley et al. 2002). Chytrid fungus has been confirmed in Oregon spotted frogs near Sunriver in central Oregon (J. Bowerman, pers. comm. 2005), as well as in bullfrogs in the Willamette Valley (Pearl and Green 2005). Anomalies in tooth rows of Oregon spotted frog tadpoles at the Dempsey Creek site in Washington may be attributable to chytrid fungus (K. McAllister, pers. comm. 2006). Alone, chytrid fungus may not be a concern for healthy amphibian populations; however, most of the Oregon spotted frog populations in Oregon and Washington are dealing with stressors, such as predation, competition from non-native species, and water quality degradation and the effects of chytrid fungus are likely to be exacerbated by these interactions (e.g. Parris and Baud 2004; Parris and Cornelius 2004; Parris and Beaudoin 2004). In light of the numerous amphibian extinctions attributed to chytrid fungus, it could easily pose a threat to individual Oregon spotted frog populations.

Amphibians exposed to ultraviolet-B radiation (UV-B), a type of solar radiation that can cause damage to plants and animals, may be more susceptible to pathogens and parasites that can interfere with normal development and increase mortality. Experimental tests conducted by Blaustein et al. (1999) found the hatching success of Oregon spotted frogs was unaffected by UV-B. However, Kiesecker and Blaustein (1997) found increased mortality associated with the fungus Saprolegnia ferax in amphibian embryos exposed to UV-B. This suggests the possibility that mortality is increased by the combined effects (synergism) of the fungus and UV-B.

The North American Reporting Center for Amphibian Malformations (NBII 2005) documents amphibian malformations throughout the United States. Malformations of several Rana species, including the Cascades frog (Rana cascadae), red-legged frog (Rana aurora), foothill yellow-legged frog (Rana boylii), and bullfrog, have been reported within the current and historic range of the Oregon spotted frog in Washington, Oregon, and California. There is one report from Thurston County, Washington, of an Oregon spotted frog with an extra forelimb (NBII 2005) and there are reports of malformations from Deschutes County in Oregon (Johnson et al. 2002; Bowerman and Johnson 2003).

There is growing evidence that the high frequencies of severe limb malformations are caused by a parasitic (Ribeiroia ondatrae) infection in amphibian larvae (Johnson et al. 2002). Aquatic snails (Planorbella spp.) are the exclusive intermediate host for Ribeiroia (Johnson and Chase 2004) and are found in a diversity of habitats, including ephemeral ponds, montane lakes, stock

ponds, oxbows, drainage canals, and reservoirs (Johnson et al. 2002). Johnson et al. (2002) postulate that the dramatic and widespread alterations of aquatic ecosystems, particularly the construction of small impoundments or farm ponds, may have created environments that facilitate high densities of Planorbella snails and the resulting infections from Ribeiroia. Many of the sites with high frequencies of malformations were impacted heavily by cattle and supported dense Planorbella snail populations. Malformations in multiple amphibian species were found in Washington ponds that had a history of grazing that extended back at least 50 years (Johnson et al. 2002). Johnson et al. (2002) found the frequency of malformations in larval amphibians was significantly higher than in transformed amphibians from the same system, suggesting that malformed larvae experience greater mortality prior to and during metamorphosis. High levels of Ribeiroia infection and the resulting malformations may increase mortality in wild amphibian populations and may represent a threat to amphibian populations already in decline. Johnson et al. (2002) and Bowerman and Johnson (2003) have found deformities in Oregon spotted frogs caused by this parasite. Most of the malformations found in anuran frogs were around the hind limbs, where they are more likely to be debilitating (Johnson et al. 2002) or expose the frog to increased risk of predation. While the effects of these parasite-induced malformations are clear at the individual scale, population-level effects remain largely uninvestigated. However, Biek et al. (2002) found that a reduction in juvenile or adult survival of pond-breeding amphibians is more likely to lead to population declines than reductions in other portions of frog life cycles. Therefore, it is reasonable to infer that where Planorbella snails coincide with Oregon spotted frogs, malformations will occur that will likely result in mortality of juvenile frogs, which can result in an Oregon spotted frog population decline at that location.

Predation: The warmwater microhabitat requirement of the Oregon spotted frog, unique among native ranids of the Pacific Northwest, exposes it to a number of introduced fish species (Hayes 1994). Introduced fish species within the historic range of the Oregon spotted frog may have contributed to losses of populations. These introduced species include smallmouth bass (Micropterus dolomieu), largemouth bass (Micropterus salmoides), pumpkinseed (Lepomis gibbosus), yellow perch (Perca flavescens), bluegill (Lepomis macrochirus), brown bullhead (Ameiurus nebulosus), black crappie (Pomoxis nigromaculatus), warmouth (Lepomis gulosus), brook trout (Salvelinus fontinalis), rainbow trout (Oncorhynchus mykiss), and fathead minnow (Pimephales promelas) (Hayes and Jennings 1986; Hayes 1997; Hayes et al.1997; McAllister and Leonard 1997; J. Engler, pers. comm. 1999). Oregon spotted frogs, which are palatable to fish, did not evolve with these introduced species and may not have the mechanisms to avoid predatory fish that prey on the tadpoles of native amphibians.

Surveys from 1993 to 1997 in British Columbia, Washington, and Oregon documented at least one introduced predator in 20 of 24 sites (Hayes et al. 1997). Brook trout, occurring at 18 sites, was the most frequently recorded introduced predator. Although differences in temperature requirements between the two species may limit their interactions, brook trout apparently occur with the Oregon spotted frog at coldwater springs, where the latter species probably overwinters and where cooler water is favorable to brook trout (Hayes et al. 1997). Brook trout predation may have affected Oregon spotted frog populations during the 1992 and 1994 droughts (Hayes et al. 1997). Brook trout are likely to prey on Oregon spotted frog larval stages under drought conditions. Dropping water levels cause overlap in habitat use between these two species by

reducing refuges and concentrating vulnerable life stages of the Oregon spotted frog (Hayes et al.1997; Hayes 1998b).

Demographic data suggest introduced fish have a negative effect on Oregon spotted frogs because sites with a significant numbers of brook trout and/or fathead minnow have a disproportionate ratio of older spotted frogs to juvenile frogs (i.e., poor recruitment) (Hayes 1997, 1998a). Field experiments have not been conducted which evaluate the role of predation by introduced fish on Oregon spotted frogs. There are, however, relevant studies of the relationship between introduced fish and closely related frog species. A study of the impacts of introduced trout on Columbia spotted frog (Rana luteiventris) populations in Idaho revealed that, although fish and adult frogs coexisted at many of the stocked lakes, most stocked lakes contained fewer than 10 adult frogs and no egg masses or tadpoles (Pilliod and Peterson 1997). Other factors probably complicate the apparent cause and effect relationship between introduced fish and the Oregon spotted frog. Field experiments have demonstrated that smallmouth bass in combination with introduced bullfrogs negatively affect red-legged frogs by influencing their microhabitat use, growth, and development (Kiesecker and Blaustein 1998). Pearl (1999) concluded that brook trout are probably the most significant threat to one population in the Oregon Cascades and, when combined with low water conditions, can lower recruitment in drought years. While experimental data are sparse, field surveys involving other western amphibians (e.g., Adams 1999, Monello and Wright 1999, Bull and Marx 2002, Vredenberg 2004, Knapp 2005, Pearl et al. 2005) strongly suggest that introduced fish represent a significant threat to Oregon spotted frogs (Pearl 1999).

Bullfrogs within the historic range of the Oregon spotted frog may have contributed to losses of populations. Bullfrogs have been introduced into the Pacific Northwest from eastern North America. They can reach high densities due to large numbers of eggs per breeding female and unpalatability (and high survivorship) of larvae (Cohen and Howard 1958; Kruse and Francis 1977; Adams et al. 2003). Bullfrog adults achieve larger size than native western ranids and even juvenile bullfrogs can consume native frogs (Hayes and Jennings 1986; Pearl et al. 2004). Bullfrog larvae can outcompete or displace native larvae from their habitat or optimal conditions (Kupferberg 1997, Kiesecker and Blaustein 1998, Kiesecker et al. 2001).

Recent research indicates that Oregon spotted frogs are more susceptible to predation by adult bullfrogs than are northern red-legged frogs (Pearl et al. 2004). Oregon spotted frogs and northern red-legged frogs historically coexisted in areas of the Pacific Northwest that are now invaded by bull frogs. However, the Oregon spotted frog has declined more severely than the northern red-legged frog. Pearl et al. (2004) demonstrated in laboratory experiments that the more aquatic Oregon spotted frog juveniles are consumed more than northern red-legged frog juveniles by bull frogs, which prefer aquatic microhabitats. Oregon spotted frogs and northern red-legged frogs also differ in their ability to escape bull frogs, with Oregon spotted frogs having shorter mean and maximum jump distances than northern red-legged frogs of equal size. Bull frogs, therefore, pose a greater threat to Oregon spotted frogs. Microhabitat use and escape abilities may be limiting Oregon spotted frog distributions in historic lowland habitats where red-legged frog populations are more stable (Pearl et al. 2004).

Bullfrogs share similar habitat and temperature requirements with the Oregon spotted frog, and

overlap in time and space between the two species is probably extensive (Hayes 1994; Hayes et al. 1997). The introduction of bullfrogs may have played a role in the disappearance of Oregon spotted frogs from the Willamette Valley and the Puget Sound area in Washington (Nussbaum et al. 1983). The digestive tracts of a sample of 25 adult bullfrogs from Conboy Lake contained nine Oregon spotted frogs, including seven adults (McAllister and Leonard 1997). A later examination of the stomachs of two large bullfrogs revealed two adult or subadult Oregon spotted frogs in one stomach and four in the second (M. Hayes, pers. comm. 1999).

Bullfrogs, however, have probably coexisted with Oregon spotted frogs for nearly 50 years in the Glenwood Valley, which includes Conboy Lake NWR (Engler and Hayes 1998). The coexistence of these two species at this site may be related to differences in seasonal and permanent wetland use. Some female spotted frogs reach a larger size at Conboy Lake than anywhere within the species' range and do not appear to be vulnerable to bullfrog predation. Bullfrogs, however, tend to be smaller at Conboy Lake than elsewhere in their range. There is also some evidence that winterkill may be a factor in controlling the bullfrog population at Conboy Lake (Engler and Hayes 1998).

Summary of disease and predation: Saprolegnia, chytrid fungus, and Ribeiroia have been found in Oregon spotted frogs and compounded with other stressors, such as UV-B exposure, degradation of habitat quality, or increased predation pressure, can contribute to population declines. Chytrid fungus and Ribeiroia, in particular, infect post-metamorphic frogs and reductions in these life stages are more likely to lead to population declines in pond-breeding amphibians. At least one non-native predaceous species has been detected at most Oregon spotted frog sites. Introduced fish prey on tadpoles and can significantly threaten Oregon spotted frog populations, especially during droughts. Bullfrogs prey on juvenile and adult Oregon spotted frogs and bullfrog larvae can outcompete or displace Oregon spotted frog larvae, effectively reducing all Oregon spotted frog life stages and posing a significant threat to Oregon spotted frog populations.

D. The inadequacy of existing regulatory mechanisms.

The Oregon spotted frog was listed as a State endangered species in Washington in August 1997 (Watson et al. 1998, 2000, 2003; WAC 232–12–014). Although there is no State Endangered Species Act in Washington, the Washington Fish and Wildlife Commission has the authority to list species (RCW 77.12.020). State listed species are protected from direct take, but their habitat is not protected (RCW 77.15.120). Under the Washington State Forest Practices Act the Washington State Forest Practices Board has the authority to designate critical wildlife habitat for State listed species affected by forest practices (WAC 222–16–050, WAC 222–16–080). However, critical wildlife habitat has not been designated by the Washington State Forest Practices Board for the Oregon spotted frog. Washington has prepared a draft Comprehensive Wildlife Conservation Strategy (CWCS) (WDFW 2005). The plan is a non-regulatory statewide approach to conservation in Washington and fulfills a requirement to access two new Federal grant programs. The draft CWCS identifies the Oregon spotted frog as a "species of greatest conservation need" with a high number of threats, a high vulnerability, and a partly adequate amount of current protection. The draft strategy describes the basic biology and distribution, general and specific problems, and general conservation strategies for the Oregon spotted frog.

It also identifies specific conservation actions including protecting known sites and potential habitat, controlling bull frogs and predatory fish, conserving beaver populations and dynamic stream process, and investigating limiting factors. Development of the Washington CWCS has proceeded on a parallel track with completion of ecoregional assessments for nine ecoregions within Washington. When the ecoregional assessments are completed in 2006, they will establish conservation targets and map biodiversity at the ecoregional level and will build on the CWCS by influencing how and where WDFW and its conservation partners direct their future CWCS implementation efforts and funds within each ecoregion. However, it is unknown how and when this strategy will be implemented.

Oregon has a State Endangered Species Act, but the Oregon spotted frog is not State listed. Although this species is on the Oregon sensitive species list and is considered critically sensitive, this designation provides little protection (ODFW 1996, OAR 635–100–0040). Once an Oregon "native wildlife" species is federally listed as threatened or endangered, it is included as a State listed species and receives some protection and management, primarily on State owned or managed lands (OAR 635–100–0100 to OAR 635–100–0180; ORS 496.171 to ORS 496.192). Oregon has prepared a draft Comprehensive Conservation Strategy. The plan is a non-regulatory statewide approach to conservation in Oregon and fulfills a requirement to access two new Federal grant programs. The draft strategy identifies the Oregon spotted frog as a "strategy species". Strategy species are rare and at-risk species and the plan targets conservation actions for the most at-risk species. The strategy generally identifies special habitat needs, limiting factors and data gaps for the Oregon spotted frog. It also identifies general conservation actions including maintaining vegetation buffers around known populations, controlling bullfrogs and invasive fish at priority sites, careful management of livestock grazing at occupied montane wet meadows, and the need for feasibility studies to guide specific conservation actions and management decisions for reintroductions. The strategy also identifies ecoregion opportunity areas. For example, Big Marsh is identified as an ecoregion opportunity area, and Oregon spotted frogs are a key species for this opportunity area. Identified conservation actions include "maintain or enhance in-channel watershed function, connection to riparian habitat, flow and hydrology". However, it is unknown how and when this strategy will be implemented.

Oregon adopted revised water quality standards for temperature, intergravel dissolved oxygen, and antidegradation in December 2003 and EPA approved these revised standards in March of 2004 (Oregon Department of Environmental Quality 2005). Although candidate species were not the focus, it was believed that the proposed standards would likely protect native aquatic species. The proposed temperature standards are intended to restore thermal regimes to protect sensitive native salmonids and if temperature is not a limiting factor in sustaining viable salmonid populations, other native species would likely be protected (Environmental Protection Agency 2004). However, as of January 2006, many of the streams associated with Oregon spotted frog habitat are listed by the Oregon Department of Environmental Quality as not meeting water quality standards for multiple parameters.

Only species that have been proposed for listing are covered by the conference provision under section 7(a)(4) of the Act. However, FWS policy requires candidate species be treated as proposed species for purposes of intra-FWS consultation where FWS's actions may affect candidate species (e.g., candidate species on NWR). This provides some measure of protection

for the Oregon spotted frog on FWS lands and from FWS activities.

Although the Act does not provide protection to candidate species, we recommend that Federal agencies confer with us on candidates, but there is no requirement that they do so. Because this species is a candidate, both the BLM and Forest Service are subject to laws, regulations, and land management plans applicable to their agencies that address the need to protect sensitive, candidate, and federally listed species, as well as their habitat. The Oregon spotted frog is listed on the Oregon BLM Special Status Species List (March 2005) and on the Forest Service Region 6 Regional Forester's Sensitive Animal List (2004). Federal management for this species follows Region 6 Forest Service Sensitive Species policy, and OR/WA BLM Special Status Species policy. For Region 6 Forest Service administered lands, the Sensitive Species policy requires the agency to maintain viable populations of all native and desired non-native wildlife, fish, and plant species in habitats distributed throughout their geographic range on National Forest lands. Management "must not result in a loss of species viability or create significant trends toward federal listing" (FSM 2670.32) for any identified sensitive species. However, this decision is made at the District level, which does not ensure consistent application of the policy.

Section 404 of the Clean Water Act is the primary Federal law that is relevant to the Oregon spotted frog's aquatic habitat. Through a permit process under section 404, the U.S. Army Corps of Engineers (Corps) regulates the discharge of all fill into waters of the United States, including navigable waters and wetlands. In Washington and Oregon current section 404 regulations allow the issuance of nationwide permits for projects involving the permanent loss of less than 1.2 ha (3 ac) of headwaters or isolated waters, including wetlands, unless a listed species may be jeopardized. Projects under a nationwide permit receive minimal public and agency review; additionally, agency notification is not required for all nationwide permits. Individual permits, which are subject to a more rigorous review, could be required for projects that have more than minimal impacts. The Corps, however, rarely requires an individual permit when a project qualifies under a nationwide permit, unless a threatened or endangered species or other resources are significantly and adversely affected by the project, although an adverse affect, alone, does not warrant an individual permit. Oregon spotted frog habitat could be affected by a project requiring an individual or nationwide permit from the Corps. For nationwide permits, depending upon the project type and the amount of wetland to be impacted, Corps notification may not be required or the impacts to wetlands may be allowed with no compensatory mitigation. For example, a single-family residence can fill up to 0.25 acre of wetland with no requirement for compensatory mitigation. If compensatory mitigation is required, although preferred, in kind mitigation is not required. Therefore, an activity that fills Oregon spotted frog habitat could mitigate by restoring and or creating riparian habitat suitable for fish, but which is not suitable for frogs. In general, most riparian habitat restoration in Washington is targeted towards salmon species and does not include floodplain depression wetlands. Furthermore, projects that occur adjacent to or that may negatively change the hydrology of Oregon spotted frog habitat are not subject to section 404 unless dredging or filling of a wetland or waterway is part of the project. Habitat can also be affected by agricultural practices that are exempt from regulation under section 404 of the statute, such as maintenance of existing agricultural drainage systems and other activities associated with an ongoing farming operation in existing cropped wetlands.

E. Other natural or manmade factors affecting its continued existence.

Site size and isolation: Most species' populations fluctuate naturally in response to weather events, disease, predation, or other factors. These factors, however, have less impact on a species with a wide and continuous distribution. Smaller, isolated populations are generally more likely to be extirpated by stochastic events and genetic drift (Lande 1988). Genetic work by Blouin (2000) indicates (1) each of the four main Oregon spotted frog groups (Chehalis and Columbia drainages, central Oregon Cascades, and the Klamath basin) have low effective population sizes, (2) substantial genetic drift occurs among the groups, and (3) genetic connectedness is low. Therefore, the small sizes and isolation of the majority of Oregon spotted frog sites increases their vulnerability of extirpation from factors such as fluctuating water levels, disease, and predation.

Egg mass count data suggests there is a significant link between site size and Oregon spotted frog breeding population size (Pearl and Hayes 2004) and larger sites are more likely to provide the seasonal microhabitats required by Oregon spotted frogs, have a more reliable prey base, and include overwintering habitat. The minimum amount of habitat thought to be required to maintain an Oregon spotted frog population is about 4 ha (10 ac) (Hayes 1994; Pearl 1999). However, smaller sites generally have a small number of frogs and, as described above, are more vulnerable to extirpation. Some sites in Oregon are at or below the 4-ha threshold; however, Pearl and Hayes (2004) believe that these sites were historically subpopulations within a larger breeding complex and Oregon spotted frogs may only be persisting in these small sites because the sites interact or seasonal habitat needs are provided nearby.

Movement studies suggest Oregon spotted frogs are limited in their overland dispersal and potential to recolonize sites. Movements (> 1 kilometer) have been documented within large wetland complexes (Watson et al. 2003) and linear riparian systems (Pearl and Hayes 2004), but these are likely rare (see Biological Information section). Most Oregon spotted frog movements are associated with aquatic connections (Watson et al. 2003; Pearl and Hayes 2004). However, 24 of 28 sites evaluated by Hayes (1997) and Pearl (1999) are isolated and separated by considerable distances (at least 16 kilometers (10 miles) in some cases) and in many cases the intervening habitat lacks the substantial hydrological connections (Hayes 1997) that would allow Oregon spotted frog movement. In addition, widespread predaceous fish introductions within these corridors pose a very high risk to frogs that do try to move between sites. Therefore, should a stochastic event occur that results in the extirpation of a population, natural recolonization is unlikely at the 82 percent of Oregon spotted frog sites which have a high degree of isolation (Hayes 1997; Hayes et al. 1997; Pearl 1999)

Population Turnover Rates: Modeling across a variety of amphibian taxa suggests pond-breeding frogs have high population variance and high local extinction rates relative to other groups, and that smaller frog populations experience disproportionately large population fluctuations (Green 2003). The vulnerability of Oregon spotted frog egg masses to fluctuating water levels (Hayes et al. 2000; Pearl and Bury 2000), the vulnerability of post-metamorphic stages to predation (Hayes 1994), and low overwintering survival (Hallock and Pearson 2001) can contribute to relatively rapid population turnovers and suggest Oregon spotted frogs may be vulnerable to extirpation from stochastic and chronic sources of mortality (Pearl and Hayes

2004).

Breeding Effort Concentrations: Oregon spotted frogs focus a large proportion of their breeding effort in relatively few locations (Licht 1971; Leonard 1997; Hayes et al. 2000; Pearl and Bury 2000; McAllister and White 2001). For example, Hayes et al. (2000) found that 2 percent of breeding sites accounted for 19 percent of the egg masses at the Conboy Lake NWR and similar breeding concentrations have been found elsewhere in Washington and in Oregon. A stochastic event at any one of these productive sites could significantly reduce the Oregon spotted frog population associated with that site.

Fluctuating Water Levels: Changes in water levels due to drought, which have been exacerbated by human modification, can cause seasonal loss of habitat and degradation of essential shoreline vegetation. Hayes (1997) assessed 9 of 24 (38 percent) Oregon spotted frog sites as having a moderate to high risk from drought. Drought risk was based on the potential for a drop in water level that could reduce or eliminate the species' habitat. Sites with the greatest risk included those depending on surface flow rather than flows from springs, and sites having low precipitation levels. Sites with the greatest risk from drought are in the Klamath and Deschutes basins of Oregon (Hayes 1997; Hayes et al. 1997). The impact of a drought on an Oregon spotted frog population depends on the amount of complex marsh habitat at a site, the availability of alternative breeding and rearing areas, and the abundance of aquatic predators (Pearl 1999). The Klamath Basin has had six consecutive years of below-normal precipitation, with 2001 being one of the driest years on record, which has resulted in reduced water quality and reduced Oregon spotted frog reproduction due to dessication (see population status and Table 1).

Although the Chemult Ranger District, Winema National Forest, in Oregon documented 335 egg masses in 1999 (Forbes and Peterson 1999) and 320 egg masses in 2000 (T. Simpson, pers. comm. 2003), adverse water conditions impacted the Oregon spotted frog populations in two subsequent years. In 2001, severe low water conditions due to low winter snowpack and drought limited Oregon spotted frogs to three small, disjunct areas representing less than 25 percent of their typical habitat. Although there were good water depths in the breeding pools in 2002, only 60 egg masses were found and 50 percent of the eggs did not hatch. The impacts of the drought were further complicated by limitations of Oregon spotted frogs to only 50 percent of their typical summertime habitat, algal blooms, poor water quality, low dissolved oxygen, loss of protective habitat, and alteration of the bank condition (USFS unpublished data).

Water Quality and Contamination: Water acidity (low pH) can inhibit fertilization and embryonic development in amphibians, reduce their growth and survival through physiological alterations, and produce developmental anomalies (Hayes and Jennings 1986; Boyer and Grue 1995). A low pH may enhance the effects of other factors, such as activating heavy metals in sediments. An elevated pH, acting singly or in combination with other factors such as low dissolved oxygen, high water temperatures, and elevated un-ionized ammonia levels, may have detrimental effects on developing frog embryos (Boyer and Grue 1995).

Studies comparing responses of amphibians to other aquatic species have demonstrated that amphibians are as sensitive, and often more sensitive, than other species when exposed to

aquatic contaminants (Boyer and Grue 1995). Immature amphibians absorb contaminants during respiration through the skin and gills. They may also ingest contaminated prey. Pesticides, herbicides, heavy metals, nitrates and nitrites, and other contaminants introduced into the aquatic environment from urban and agricultural areas are known to negatively affect various life stages of a wide range of amphibian species, including ranid frogs (Hayes and Jennings 1986; Boyer and Grue 1995; Hecnar 1995; Materna et al.1995, NBII 2005).

The use of synthetic pyrethroids for insect pest control, including use in agricultural and aquatic systems, has increased. Although pyrethroids are relatively nontoxic to birds and mammals, they are extremely toxic to aquatic organisms, including fish and invertebrates. Their effects on amphibians, however, are less well-known. Materna et al. (1995) demonstrated negative effects (inactivity, convulsive actions, and death) of one widely used synthetic pyrethroid pesticide, esfenvalerate, on leopard frog (Rana spp.) tadpoles in laboratory and field experiments. Methoprene, another chemical widely applied to wetlands for mosquito control, has been linked to abnormalities in southern leopard frogs (Rana utriculata), including completely or partially missing hind limbs, discoloration, and missing eyes. Missing eyes and delayed development in northern cricket frogs (Acris crepitans) have also been linked to methoprene (Donald W. Sparling, Patuxent Wildlife Research Center, pers. comm. 1999).

In 1999, Four Rivers Vector Control planned to apply pyrethroids, methoprene, and other pesticides in wetlands and other bodies of water within the range of the Oregon spotted frog. This company is funded primarily by homeowners, homeowner associations, and businesses in the Sunriver area of Oregon to control mosquitoes. Due to the concerns about the use of methoprene and the possible effects of the mosquito abatement program on the Oregon spotted frog, the company is not permitted to use the chemical on the Deschutes National Forest and is voluntarily restricting its use to a few sites. Similar proposals are possible in the future.

Poor water quality and water contamination have probably played a role in the decline of Oregon spotted frogs, although data specific to this species are limited. Eutrophic (nutrient-rich) conditions, characterized by blooms of algae that can produce a high pH and low dissolved oxygen, have increased in Upper Klamath Lake and may have contributed to the absence of Oregon spotted frogs. Beginning in 2002, algal blooms, poor water quality, and low dissolved oxygen were documented in Jack Creek. A decline in Oregon spotted frog reproduction was also documented during this time (T. Simpson, pers. comm. 2003; J. Oertley, pers. comm. 2005).

Johnson and Chase (2004) point to elevated levels of nutrients (particularly phosporus) from agricultural fertilizers and cattle grazing in freshwater ecosystems as the cause of shifting the composition of aquatic snails from small species to larger species that serve as intermediate hosts for a parasite that causes malformations in amphibians (see Disease).

Marco (1997) demonstrated the strong sensitivity of Oregon spotted frog tadpoles to nitrate and nitrite ions and suggested that nitrogen-based chemical fertilizers may have contributed to the species' decline in the lowland areas of its distribution. Recommended levels of nitrates and nitrites in drinking water are moderately to highly toxic for Oregon spotted frogs, indicating EPA water quality standards do not protect sensitive amphibian species (Marco et al. 1999).

Although the effects on amphibians of rotenone, used to remove undesirable fish from lakes, are poorly understood, mortality likely occurs at treatment levels used on fish. The role of rotenone treatments in the disappearance of Oregon spotted frogs from historic sites, however, is unknown (Hayes 1997).

Hybridization: Hybridization between Oregon spotted frogs and closely related frog species is unlikely to affect the survival of the Oregon spotted frog. Hybridization between Oregon spotted frogs and Cascade frogs has been demonstrated experimentally and verified in nature (Haertel and Storm 1970; Green 1985). However, the offspring are infertile, and the two species seldom occur together. No Oregon spotted frog and Columbia spotted frog populations are known to occur together.

Correlated factors: Amphibian declines may frequently be associated with multiple correlated factors (Adams 1999). Two of the greatest threats to freshwater systems in western North America, exotic species and hydrological changes, are often correlated. In addition, occurrence and abundance of bullfrogs may be linked with invasions by nonnative fish (Adams et al. 2003). Adams (1999) examined the relationships among introduced species, habitat, and the distribution and abundance of red-legged frogs in western Washington. Red-legged frog occurrence in the Puget lowlands was more closely associated with habitat structure and exotic fish than with the presence of bull frogs, and similar associations were found in a recent study in Oregon's Willamette Valley (Pearl et al. 2005). The spread of exotics is correlated with a shift toward greater permanence in wetland habitats regionally (e.g. Kentula et al. 1992). Exotic fish and bullfrogs are associated with permanent wetlands. Conservation of more ephemeral wetland habitats may have direct benefits for native amphibians and may reduce the threat of exotic fish and bull frogs (Adams 1999).

CONSERVATION MEASURES PLANNED OR IMPLEMENTED

Washington:
In 2002, restoration planning came to fruition on the 110th Avenue and 123rd Avenue sites. The hydrology at the 110th Avenue site was enhanced by excavating soil to create ponded surface water that would remain wet through mid-summer. The 123rd Avenue site was enhanced by removing the reed canarygrass root mat and removing enough soil to bring the elevation to the same level as existing nearby wetland marsh areas. In addition, small areas were excavated deeper (1 – 2 feet) to provide surface water in dry years. Between the two sites, a maximum of 15 acres was enhanced for Oregon spotted frogs.

The Nisqually NWR is in active acquisition status at the Black River Unit, which encompasses most of the Dempsey Creek site and all of the 110th and 123rd Avenue sites. One of the goals of acquiring parcels within this unit is to protect Oregon spotted frog habitat.

In 1995, Ridgefield NWR Complex initiated a series of distributional surveys for a variety of species, including the Oregon spotted frog, at Conboy Lake NWR. Subsequent research at Conboy Lake, in cooperation with Dr. Marc P. Hayes, has included demographic studies, egg mass surveys, and a bullfrog diet study to assess the impacts of bullfrog predation on Oregon spotted frogs. In 1999−2002, Conboy Lake NWR initiated several wetland restoration projects

to restore natural hydrological processes to portions of the refuge. This enabled the refuge to maintain independent water management of several wetlands, regardless of the water-related impacts of local landowners. Approximately 60 percent of all egg masses in 2002 were located on wetland units that have received some level of restoration since 1999. This restoration activity has included lowering and reshaping dikes, constructing spillways and swales in lieu of water control structures, installing new water control structures where applicable, and filling drainage ditches. Despite the apparent success of these restoration activities, the vast majority of the refuge and adjacent private wetlands have nonviable subpopulations of Oregon spotted frogs, and some have disappeared from these habitats since 1998. In 2001, the refuge signed an agreement with several of the local landowners to maintain adequate water levels until June to facilitate spotted frog metamorphosis and recruitment on approximately 810 ha (2,000 ac) of wetlands. Unfortunately, this agreement is now defunct and one landowner refuses to allow the refuge to hold water in 2006 (J. Engler, pers. comm. 2006). Inadequate water or poorly timed water management activities continue to be the most significant threat to Oregon spotted frog recruitment and survival in the Glenwood valley, which includes Conboy Lake NWR (J. Engler, pers. comm. 2003).

In 1997, Port Blakely Tree Farms, WDFW, and the FWS initiated a cooperative study in response to the interest of private landowners to better manage and protect property for the Oregon spotted frog at the Dempsey Creek site. The goals of this study were to examine this species' habitat use patterns, especially as they relate to hydrology and cattle grazing, and to estimate the size of this population, develop an index to monitor population trends, determine seasonal movements, and identify sexual differences in movement patterns (Watson et al. 2000). The information gathered in the study is being used by Port Blakely Tree Farms towards maintaining the habitat condition as it was described in the study.

Oregon:
A partnership of several Federal agencies (Bureau of Reclamation (BOR), Forest Service, FWS, and USGS), the ODFW, the Sunriver Nature Center, and North Unit Irrigation District are currently cooperating in an effort to conserve an Oregon spotted frog population that occupied a drainage ditch at the base of Wickiup Dam near Bend, Oregon. Activities associated with the reinforcement of the dam eliminated the ditch that provided breeding, rearing, and adult habitat for a small population of Oregon spotted frogs. A conservation plan was developed that included habitat creation, population relocation, and biological monitoring for the period immediately following translocation. In 2000, explosives were used to create six ponds in nearby Dilman Meadows on the Deschutes National Forest. Nine egg masses were moved from the ditch to the ponds in spring 2001; adult and juvenile frogs were captured by trapping and dip netting and transferred in early summer. Eight adult frogs received transmitters to monitor their locations, and data indicated none left the ponds. Young frogs were found in ponds where the egg masses had been introduced. Juvenile and adult frogs were found aggregating in one deep, flowing spring at the beginning of winter (Korson and Pearl 2002; C. Pearl, pers. comm. 2003). Oregon spotted frogs from the original translocated egg masses have reached sexual maturity and breeding has occurred. Two adult females that were part of the original translocation survived into 2004. The original ponds are revegetating at a rapid rate, reducing depth and the amount of open water habitat. Three additional ponds were excavated in 2004, in hopes that they will better resist vegetation establishment and allow direct maintenance if required (Sandra Ackley,

FWS, pers. comm. 2004, C. Pearl, pers. comm. 2005).

In July 2000, the FWS entered into a Conservation Agreement with the Forest Service and ODFW. The objective of the Conservation Agreement is the protection and conservation of the two Oregon spotted frog populations in the Mink Lake Basin in the Three Sisters Wilderness Area of the Willamette National Forest. Survey, monitoring, management, and education activities are being conducted during this 10-year agreement and are being used to address threats that include site size, introduced fish (i.e., brook trout), effects of drought, habitat succession, and isolation of these populations. Monitoring at one of these sites (Penn Lake) by the USGS was expanded in 2000 to include data collection on Oregon spotted frog movement patterns at montane sites using PIT tagged individuals. Two Oregon spotted frog projects funded in 2000 by the Species-at-Risk Program of the Biological Resource Division of the USGS included a genetics study and a study of a population's status, effects of introduced fish, and habitat associations.

Big Marsh in the Oregon Cascades Recreation Area, upper Deschutes basin, hosts one of the largest remaining Oregon spotted frog populations. Habitat restoration activities at the site are ongoing. Restoring wetland values and providing for semi-primitive recreation are goals for this area. In 1996 and 1997 restoration efforts involved installation of dams and breaches in the west ditch, which successfully restored water to an area of the marsh that previously was dry yearround. In a wildfire area that received water from the restoration efforts, small ponds created by fire burning into roots and peat held Oregon spotted frogs. In 2004, portions of the west ditch were filled in allowing water to flow into the marsh, and ponds were also created. Prescribed burns were conducted by the Forest Service over most of the marsh to remove thatch, and benefit native grasses, sedges, and willows. Egg mass surveys have been conducted every year from 2001 through 2005, and are useful as one potential measure of the effectiveness of the restoration efforts. Between 2001 and 2005, egg mass numbers increased from 230 to 1,254 (see Table 1), presumably as a result of the restoration activities.

The Winema National Forest is in the planning stages for making changes to the grazing regime along Jack Creek. Changes are likely to include some type of fencing for livestock in the Jack Creek area (J. Oertley, pers. comm. 2005), although funding for implementation is currently lacking.

The FWS (Klamath Falls Fish and Wildlife Office), Forest Service, BLM, BOR, and the Nature Conservancy are actively involved in restoring and enhancing wetlands in the Klamath Basin. The Klamath Falls Fish and Wildlife Office has participated in restoration of approximately 2,023 ha (5,000 ac) and enhancement of another 17,000 ha (42,000 ac) of wetlands on Federal and private lands since 1997. The Nature Conservancy has a large project of approximately 3,238 ha (8,000 ac) in progress along the north side of Upper Klamath Lake. More than 50 percent of the restored wetlands would be considered potential Oregon spotted frog habitat. However, the only one currently known to be occupied is the Wood River area, which was occupied prior to restoration activities.

SUMMARY OF THREATS (including reasons for addition or removal from candidacy, if appropriate)

The Oregon spotted frog faces a number of threats, and most populations are subjected to multiple threats which cumulatively pose a risk to individual populations. Suitable habitat is continuing to be impacted and/or destroyed by human activities that result in the loss of wetlands, hydrologic changes, livestock grazing, vegetation encroachment or succession, and contaminants. The oomycete water mold Saprolegnia, chytrid fungus, and Ribeiroia have been documented in Oregon spotted frogs and compounded with other stressors can contribute to population declines. Introduced fish species and bullfrogs prey on Oregon spotted frogs, particularly juveniles, which results in poor Oregon spotted frog recruitment. Bullfrogs also outcompete or displace Oregon spotted frogs from their habitat. The small sizes and isolation of the majority of Oregon spotted frog sites makes Oregon spotted frog populations vulnerable to fluctuating water levels, disease, predation, poor water quality, and extirpation and makes natural recolonization unlikely. Oregon and Washington have both included the Oregon spotted frog in their Comprehensive Conservation Strategies; however, it is unknown how and when these strategies will be implemented. Federal land management actions are not supposed to create a significant trend toward federal listing; however it is unclear what level of protection the Oregon spotted frog will be afforded under this policy. A legacy of past effects which has led to a highly fragmented distribution, combined with the current threats and the biological sensitivity of the Oregon spotted frog to these threats, leads to the conclusion that this species continues to meet the definition of a candidate.

For species that are being removed from candidate status:

N/A Is the removal based in whole or in part on one or more individual conservation efforts that you determined met the standards in the Policy for Evaluation of Conservation Efforts When Making Listing Decisions (PECE)?

RECOMMENDED CONSERVATION MEASURES

Assess chytrid fungus presence and effects to Oregon spotted frogs rangewide.

LISTING PRIORITY

THREAT			
Magnitude	Immediacy	Taxonomy	Priority
High	**Imminent**	Monotypic genus	1
		Species	**2***
		Subspecies/population	3
	Non-imminent	Monotypic genus	4
		Species	5
		Subspecies/population	6
Moderate	Imminent	Monotypic genus	7
		Species	8

to Low	Non-imminent	Subspecies/population Monotypic genus Species Subspecies/population	9 10 11 12

Rationale for listing priority number:

Magnitude: A high magnitude of threat is warranted for this species for a variety of reasons. It is absent from at least 76 percent of its historic range, and remaining populations in Oregon, Washington, and British Columbia are typically small and isolated. The number of Oregon spotted frogs at only 5 sites can be considered stable, whereas 4 sites are declining and the status at 27 sites is undetermined. Many of the small sites are at risk of extirpation from stochastic events, both natural or human-caused. In addition, there is no genetic interchange between the four groups designated by Blouin (2000) due to the distance separating them and lack of aquatic habitat available for dispersal. In Washington, all of the sites are threatened by either development, fluctuating water levels, and/or lack of management of exotic vegetation and predators. In Oregon, all of the sites are subject to one or more of the following threats: fluctuating water levels, non-native predaceous species, exotic vegetation encroachment, vegetation succession, and livestock grazing. While the risk to an individual site from each of these factors may vary, the cumulative risk of these threats to each site is high. This is reflected in declining and/or small populations which constitute the majority the Oregon spotted frog's distribution.

Imminence: Although some conservation measures, including habitat restoration, are being initiated for some populations, most continue to be unmanaged. Wetland habitat continues to be modified by agricultural practices and water manipulation in Washington. Historic hydrological changes reduced or eliminated Oregon spotted frog habitat and continued operations of water diversions result in inundation, dessication, and continued destruction of habitat through vegetation succession. New hydrological changes occur as developments are placed adjacent to Oregon spotted frog habitat. Past introductions of non-native predaceous species continue to place predation pressure on the remaining Oregon spotted frog populations. Past introductions of exotic vegetation continue to encroach upon and reduce Oregon spotted frog habitat. Therefore, an imminent immediacy of threat is warranted for this species.

Yes Have you promptly reviewed all of the information received regarding the species for the purpose of determining whether emergency listing is needed?

Is Emergency Listing Warranted? No. Although there are few populations, each facing a variety of threats, there are no threats likely to occur to all of the populations simultaneously to result in immediate extinction of the entire species before completion of the expected normal course of the listing process.

DESCRIPTION OF MONITORING

FWS has funded and participated in surveying and monitoring activities at a number of Oregon

spotted frog sites. We maintain contact with the responsible agencies and species experts and annually request their reviews, comments, and updates to the candidate assessment forms during the revision process. Relevant literature and data for this species are obtained principally from contacts with responsible agencies and experts and their reports. Periodic literature searches for this species are also completed.

COORDINATION WITH STATES

Indicate which State(s) (within the range of the species) provided information or comments on the species or latest species assessment:

Indicate which State(s) did not provide any information or comments: Oregon and Washington

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APPROVAL/CONCURRENCE: Lead Regions must obtain written concurrence from all other Regions within the range of the species before recommending changes, including elevations or removals from candidate status and listing priority changes; the Regional Director must approve all such recommendations. The Director must concur on all resubmitted 12-month petition findings, additions or removal of species from candidate status, and listing priority changes.

Approve: Acting _____ 11/10/05
Regional Director, Fish and Wildlife Service Date

_____

Concur: _____ August 23, 2006
Director, Fish and Wildlife Service Date

Do not concur: _____ _____
Director, Fish and Wildlife Service Date

Date of annual review:
Conducted by: